

UNDERSEA WARFARE

U. S. S U B M A R I N E S... B E C A U S E S T E A L T H M A T T E R S

Welcome To *Virginia*

Virginia-class Brings
Unprecedented Capabilities
to the U.S. Submarine Force

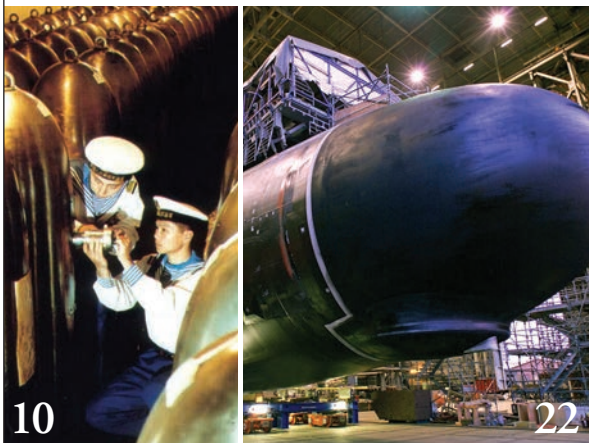
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U.S.-U.K. Tactical Cooperation

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China's Sea Mines

Virginia-class Cost Reduction Plan



UNDERSEAWARFARE

THE OFFICIAL MAGAZINE OF THE U.S. SUBMARINE FORCE

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On The Cover



USS Virginia (SSN-774), shown here undergoing testing at Naval Undersea Warfare Center Detachment Atlantic Undersea Test and Evaluation Center (AUTEC), off the coast of Florida.

Photo by Michelle Crum



"I am deeply honored for the opportunity to command our Navy's elite Submarine Force unmatched by any in the world. What makes us elite is the high quality of our people, the high standards we set for ourselves and the unmatched capabilities of our submarines."

VADM Jay Donnelly, USN, Commander, Submarine Force

It is my pleasure to address you in my first Enterprise Watch as your Submarine Force commander. It is great to be back in Norfolk and again close to the Force. I would like to give my most sincere congratulations to VADM Chuck Munns, who retired after more than 33 years of loyal dedicated service to our Navy and our nation. He was an inspired leader of our Submarine Force. On behalf of the entire Submarine Force, I would like to extend a heartfelt thank you and wish Admiral and Mrs. Munns, "Fair winds and following seas."

What I'm most proud about is our people and our ships. We continue to operate as a global force, flowing units around the world as needed to serve individually or in concert with U.S. forces and our coalition partners. Our forward deployed SSNs continue to produce information that is useful in the long war and maritime security operations and our SSBNs patrol quietly in a survivable, always-ready posture.

As your commander, I will initially focus my attention on three top priorities.

First is operational excellence. We need to refocus attention on the basics of seamanship, navigation, and safe day-to-day operations. Our standards are necessarily high and expectations are equally high. It is a constant challenge to meet those expectations but meet them we must.

Second is the professional development of our Submarine Force personnel. I recognize that every member of our force, active duty, reservist, and civilian together with their family members is vital to our success. I take my responsibility to train and develop Submarine Force leaders seriously and will devote much of my energy to that task. Our retention is currently high and attrition is low but I will seek continued improvement. Quality of life and pride in doing an important job well are keys to our overall success.

Finally, we must maintain our primacy by continuing to modernize our submarines with technology and by building new ships to replace those reaching the end of their useful lives. Our products are stealth, persistence, and deterrence and they are in great demand by our combatant commanders. We will strive to deliver those capabilities in a cost effective manner.

In February, RADM Walsh and I completed a hard-hitting and productive meeting with the Submarine Force group and afloat major commanders that featured very frank and open

discussions. Our intent was to focus on the fundamentals of operational excellence and address the barriers at the senior leadership level. We acknowledge that our commanding officers bear the responsibility to operate their ships safely and effectively.

The Undersea Enterprise continues to mature, align, and improve productivity. Your hard work identifying issues and innovative solutions are saving millions of dollars and recovering days of submarine operational availability. My three priorities will continue to guide the activity of the Enterprise through 2007.

Today, as we celebrate 107 years of operational excellence of our United States Submarine Force, we can reflect on one of our heroes, VADM Charles A. Lockwood who commanded our Pacific Submarine Forces during WWII. After the war, he reflected on the remarkable accomplishments of the submariners of that day. He said, "They were no supermen, nor were they endowed with any supernatural qualities of heroism. They were merely top-notch American lads, well trained, well treated, well armed, and provided with superb ships." It's no different today. Our people are truly top-notch. My job is to ensure they are well trained, well treated, and equipped with the best submarines in the world.

Each of you represents a vital part of a chain of activity that results in unique undersea warfare capability for the nation. The dolphins you wear represent not only your professionalism but also that of the entire Submarine Force—past, present, and future.

Again remember our rich history and what Fleet Admiral Chester Nimitz said about our WWII brothers in arms, "We shall never forget that it was our submarines that held the line against the enemy while our fleets replaced losses and repaired wounds". Keep up the good work in your respective part of the Enterprise! Smooth sailing, and good hunting.



"As a maritime nation, our ability to control the under-sea environment into the future continues to be important. We are working on capabilities to both deter and neutralize future undersea threats and assure our nation's continued access to the global commons."



RADM Van Mauney, USN, Director, Submarine Warfare

Things have picked up here in Washington, DC as the new Congress considers our Navy's (and our nation's) proposed budget for fiscal year 2008. During this process I've had the opportunity to meet, and testify before, some of our members of Congress and their staffs. It is exciting to be a part of this process where two branches of our government meet in carrying out the responsibilities assigned by our Constitution and other laws.

It is our duty in the Navy, and in OPNAV N87, here in the Nation's capital to work to provide effective capabilities to the joint force that will be relevant in the future. The *Virginia*-class attack submarine program, a significant element of our future, continues to move forward. USS *Virginia* (SSN-774) recently completed a post-construction shipyard period in March and has begun to work through a series of at-sea tests to confirm that the ship indeed possesses those capabilities that were included in the design. In April we christened *North Carolina* (SSN-777) and laid the keel for *New Hampshire* (SSN-778). USS *Hawaii* (SSN-776) was commissioned May 5 in a ceremony in Groton, Conn.

I had the honor to attend the christening of *North Carolina* a few weeks ago at Northrop Grumman Newport News (NG-NN). Having spent part of my youth growing up in North Carolina, the ceremony had special meaning. NG-NN, General Dynamics Electric Boat, the rest of the Navy team, and Mrs. Linda Bowman, the ship's sponsor, all contributed to a meaningful event that will help move this crew down the road towards the fleet. Mrs. Bowman challenged the crew to achieve excellence and to include being good shipmates and looking after each other both professionally and personally as part of each man's daily routine. This ceremony and others, like the commissioning of USS *Hawaii* held recently in Groton, are becoming more common but each is important as we work to establish the culture and standards of each crew. If you get the chance to attend, you should take the opportunity and assist in other ways to help these crews reach operational excellence.

In December, we successfully completed the first submerged escape from a U.S. submarine in over 30 years, and the first ever from a U.S. nuclear submarine, during an exercise off the coast of Alaska. The submarine rescue collaborative environment provides us with excellent opportunities to contribute to the CNO's vision of the '1000-ship Navy.' This concept envisions nations with like interests working together to provide for the safety and security of the global maritime common areas. The U.S. Navy has agreements with several nations that would provide for reciprocal submarine rescue assistance if required. We host the office of the International Submarine Escape and Rescue Liaison Office (ISMERLO) in Norfolk, Va. ISMERLO is an organization which facilitates regular planning and collaboration that would support the rapid call out of rescue systems.

Duty in Washington, DC is rewarding and challenging, serving to broaden our perspectives in many ways. Several of our shipmates from N87 departed the pattern in the past several months and I want to take this opportunity to thank them and their families for improving our Navy and our Submarine Force during their assignment. Thanks go out to RDML Mike Klein, CAPT Jim Hertlein, CAPT Duane Ashton, CAPT Chris Murray, CAPT Ed Brands, CDR Mike Rimmington, CDR Gerard Vandenberg, CDR Alan Boyd, LCDR Matt Miller, LCDR Joe Lockwood, LCDR Chris James, LT Thomas O'Donnell, LT Greg Klos, LT Joel Hartel, and CWO3 Jimmy Lee. We wish you fair winds and following seas. Thanks for your energy and contributions to the next Navy.

Vice Adm. John J. Donnelly

Commander, Submarine Force
Commander, Submarine Force, Atlantic

Rear Adm. Joseph A. Walsh

Deputy Commander, Submarine Force
Commander, Submarine Force, U.S. Pacific Fleet

Rear Adm. Carl V. Mauney

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UNDERSEA WARFARE is the professional magazine of the undersea warfare community. Its purpose is to educate its readers on undersea warfare missions and programs, with a particular focus on U.S. submarines. This journal will also draw upon the Submarine Force's rich historical legacy to instill a sense of pride and professionalism among community members and to enhance reader awareness of the increasing relevance of undersea warfare for our nation's defense.

The opinions and assertions herein are the personal ones of the authors and do not necessarily reflect the official views of the U.S. Government, the Department of Defense, or the Department of the Navy.

Contributions and Feedback Welcome

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In keeping with UNDERSEA WARFARE Magazine's charter as the Official Magazine of the U.S. Submarine Force, we welcome letters to the editor, questions relating to articles that have appeared in previous issues, and insights and "lessons learned" from the fleet.

UNDERSEA WARFARE Magazine reserves the right to edit submissions for length, clarity, and accuracy. All submissions become the property of UNDERSEA WARFARE Magazine and may be published in all media. Please include pertinent contact information with submissions.

dear EDITOR,

I am a member of the USS *Sea Poacher* (SS-406) organization. We are trying to locate or ascertain the status of this submarine which, in 1974, became a Peruvian submarine known as BAP *La Pedrera* (S-49). Our last information on the ship was in 1995 when she was in Callao, Peru and assigned as a cadet training ship. After that there is nothing ever said about her on the internet, and I have searched it extensively. I would greatly appreciate any information you might have on its status. Is it still afloat, scrapped, or possibly even sunk? Or if you have no information on it and know of someone who might, I would greatly appreciate your giving me any contact information. I am in contact with naval and defense attachés both in Washington, D.C. and Peru, various museums, and others that should know, but I have run into a brick wall.

Thank you so much.
Lanny Yeske, Ph.D.
Cmdr., U.S. Navy (Retired)

Dr. Yeske,

Unfortunately, we were unable to find any further information prior to going to press.

We plan to keep your question in our files and do some more research. Please let us know if you find anything further and we will print it here to let our readers know. Good hunting!

dear EDITOR,

Where can I find surplus genuine U.S. Navy submarine service boots for sale? A shoe repairman told me they were the best constructed footwear he ever worked on and suited to the purpose of standing endlessly on hard surfaces. Any help appreciated.

I. I. Butler

Mr. Butler,

Currently, the U.S. Navy does not issue submariners any specially designed footwear and the Naval Historical Center has no record of such a boot. U.S. submariners wear standard Navy shoes and steel-toed boots when appropriate. The Standard Submarine Organization and Regulations Manual does call for submarine sneakers. These are basic blue-canvas, white-soled boat shoes that are part of the boat's gear locker and issued to personnel working topside, and are available commercially.

sailorsFIRST



Photo by Petty Officer 2nd Class Elizabeth Thompson

Seaman Apprentice Larry Shaffer, assigned to USS *Los Angeles* (SSN-688), gives a high five to a child being treated at the Los Angeles Children's Hospital while participating in the Navy's Caps for Kids program. Crew members from *Los Angeles* visited and handed out ball caps and photos of their submarine to almost 50 children on the 6th floor surgery unit.



U.S. Navy photo

ESCAPEX:

Navy's First Escape Exercise from

Seven personnel practiced escaping from the attack submarine USS *Los Angeles* (SSN-688) and ascending to the surface wearing special suits designed to enable a free ascent from a stricken submarine. Escape Exercise (ESCAPEX) was held Dec. 2 at the U.S. Navy's Southeast Alaska Acoustic Measurement Facility in Ketchikan, Alaska.

While several foreign navies practice the maneuver routinely, the U.S. Navy had not conducted it in more than three decades, and never from a nuclear-powered submarine.

The Navy's renewed interest in submarine escape comes as U.S. submarines operate more frequently now in shallow coastal waters, said Submarine Development Squadron (CSDS) FIVE commodore Capt. Butch Howard, who oversaw the exercise.

"Today, submarines spend a greater amount of time in the littorals or shallow water, which supports the overall concept of escaping from a possible distressed submarine," said Howard. "It's imperative our

sub crews be familiar and comfortable with this operating procedure no matter how remote the potential for its use."

The MK 10 Submarine Escape Immersion Equipment, or SEIE, allows survivors to escape a disabled submarine at depths down to 600 feet, at a rate of eight or more men per hour. It is designed to enable a free ascent from the submarine and provide protection for the submariner upon reaching the surface until rescued. The assembly is comprised of a submarine escape and immersion suit, an inner thermal liner, and a gas inflated single seat life raft, all contained in an outer protective stowage compartment.

For the exercise, *Los Angeles* embarked six U.S. Navy divers, as well as a British diver from the Royal Navy. The submarine submerged to 130 feet, where each of the seven divers donned the SEIE suits, entered the escape trunk, and ascended.

Chief Petty Officer (DSW/SW) Sean Daoust, a submarine escape instructor at the Naval Submarine School in Groton,

Conn., was the first to ascend. Daoust said he was honored to be the first to escape from a U.S. nuclear-powered submarine, and couldn't wait to return to his students with his firsthand knowledge.

"I teach this procedure on a daily basis," said Daoust. "I have a lot of confidence in the system. Now I can show them the data and the statistics so it will benefit them, because if you see one of your shipmates being blasted out of a submarine, it's the best way to assure them the system works."

After Daoust, there were three tandem escapes. *Los Angeles* crew member Petty Officer 2nd Class (SS) Gary Halsey was one of the Sailors given the chance to participate in a tandem escape. While thrilled at the experience, Halsey also said it was reassuring to know that the escape system works.

"Not many people get to do things like this in their whole Navy career," said Halsey. "The SEIE worked great which instilled confidence, not to mention being very comforting to all of us working on

Submariners can have
an added degree of confidence
in knowing that the SEIE suits on
U.S. submarines can save them
in the unlikely event of a stranding.



Photo by Petty Officer 1st Class Cynthia Clark



Photo by Petty Officer 1st Class Cynthia Clark

(opposite) A sailor from the international submarine community in a SEIE participates in a submarine escape exercise during SORBET ROYALE 2005.

(far left) USS *Los Angeles* (SSN-688) moored at the Southeast Alaska Acoustic Measurement Facility Static Site in Ketchikan, Alaska as part of ESCAPEX 2006.

(left) Petty Officer 2nd Class Gary Halsey emerges from the Northern Pacific as the first U.S. Navy Sailor to execute a tandem open ocean escape from a nuclear-powered submarine.

(below) Submarine Escape Immersion Equipment (SEIE) suits seen here aboard the USS *Virginia* (SSN-774) in 2004.

in a Nuclear Submarine

submarines.”

Cmdr. Erik Burian, commanding officer of *Los Angeles*, attributed the exercise’s success to his crew’s tremendous skill and professionalism. He said he was grateful that the namesake of the *Los Angeles*-class was the boat selected to do the exercise.

“I think it’s absolutely fitting the ‘first and finest’ pulled this off,” said Burian. “It’s just perfect.”

Submariners can have an added degree of confidence in knowing that the SEIE suits on U.S. submarines can save them in the unlikely event of a stranding, said Howard.

“As a result of ESCAPEX, we’ve confirmed the procedures and our SEIE suits work,” he said. “The ship and the folks

at SEAFAC [Southeast Alaska Acoustic Measurement Facility] did a great job.”

In addition to the team from CSDS FIVE, *Los Angeles* and SEAFAC, the ESCAPEX team was made up of members of numerous commands, including Commander, Submarine Force Pacific Fleet, Naval Sea Systems Command, and Explosive Ordnance Disposal Mobile Unit ELEVEN.

Petty Officer 1st Class (SW) Cynthia Clark, USN serves in the SUBPAC public affairs office in Pearl Harbor, Hawaii.

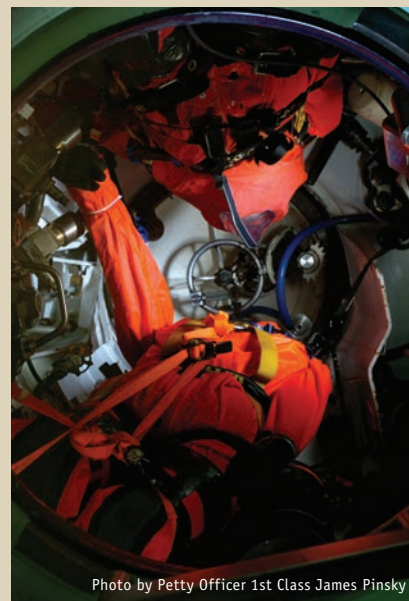


Photo by Petty Officer 1st Class James Pinsky



U.S.–U.K. Tactical Cooperation

The majority of the world's population lives within two hundred kilometers of the coastline. A great deal of commerce relies on sea transport to function, and there are some nations that support a terrorist course of action with capabilities that can be employed in the maritime arena. As a result, much of the world's population is subject to the unpredictable threat of sea- and coast-based terrorism and inter-nation rivalry.

Presently, 42 nations have submarine capabilities, and have ranging national interests. Many have the capability to land terrorist forces from the sea and to engage in acts of piracy and at-sea terrorism. This makes submarine forces key assets in the Global War on Terrorism (GWOT). Their strike capability alone is significant, and this is augmented by their ability to deploy anywhere in the world's oceans in stealth as strong force multipliers.

Submarine Development Squadron Twelve (DEVRON 12) continues to be at the forefront of submarine warfare, predicting its future direction while providing tactics to ensure dominance using both this generation of equipment and the next.

Since 1955, there has been a U.K. exchange officer stationed with the squadron, whose major purpose is to facilitate the exchange of ideas and information across the two nations' forces.

Submarine Development Squadron TWELVE

Capt. Ken Perry, is the commodore of the Squadron. It is one of the United States east coast squadrons working for Commander Submarine Group TWO (Rear Adm. Cecil Haney). The motto "Science, Technology, and Tactics" incorporates the essence of the past, present, and future. The ability to use science to provide effective technology is important; the development of tactics to



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effectively use the equipment and the supporting training is vital. Perry's squadron is unique in the world. Not only are the six submarines under his command engaged in a wide variety of submarine and support operations, but he also has a world-leading submarine tactical development (TD) organization.

The advantage of this squadron organization is that ideas for combating any potential threat can quickly be brainstormed, tested in simulators, and then taken to sea onboard the squadrons' submarines. In addition, the direct feedback from the units enables the process of idea to doctrine to be realized rapidly.

The Tactical Analysis Group (TAG) is roughly fifty percent military and fifty percent civilian contract personnel. The employees are generally recruited from the submarine world, with many being previous U.S. commanding officers. They provide not only the backbone of administration and staff work required to run many major TD exercises a year, but also a wealth of submarine knowledge.

Maritime Warfare Center (United Kingdom)

The Maritime Warfare Center (MWC) has a different organization that encompasses not only submarine warfare, but also the other spectrums of surface and air warfare. They are tasked directly by commander-in-chief fleet (CINCFLEET) to analyze issues and develop tactics to optimize the capability of the fleet. The submarine section is considerably smaller than DEVRON 12, but continues to provide the advance in U.K. submarine operations required to maintain the edge against potential adversaries.

Tactical Development Exchange

During the last century, the development of nuclear power, the deployment and maintenance of the at-sea nuclear deterrent, and many Cold War operations were conducted by the U.S. and U.K. side-by-side. Reductions in force numbers in both countries have not hindered the ability to work together into the 21st century. Submarine

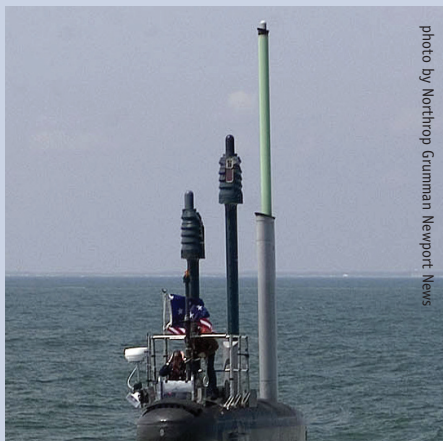


photo by Northrop Grumman Newport News

Photonics masts on the *Virginia*-class fast attack submarine USS *Texas* (SSN-775).

forces continue to provide anti-submarine warfare (ASW) security against the many potential adversaries fielding a submarine capability.

More important is the impact that submarines have in other areas of warfare and national security. For example, they provide any commander an asset that is capable of working autonomously or within a force; a unit that is eminently flexible (it can change roles instantaneously) and can remain on station for months at a time without support. Submarines provide a covert strike capability from the sea, and are capable of operating close to an enemy's coast without their knowledge.

Continuing to remain at the forefront of warfare presents two significant dilemmas. First, there is the paradox of retaining the secret nature of submarine operations while promoting their capabilities. Second, there is the issue of increasing capabilities within the limits of reduced funding levels. DEVRON 12 is an outstanding broker in achieving this.

TD plays a fundamental part in this process of advancing submarine effectiveness. It ensures that tactics and equipment are developed in a timely fashion to deal with present and future requirements. While many countries conduct some form of TD, its prevalence in the U.S. and U.K. quickly changes peacetime theory into operational practice.

While the U.K. subscribes to a different doctrine than the U.S.'s *Sea Power 21*, there are broad ideas and specific similarities that allow development as well as economy of effort towards finding solutions. Examples of this are:

- Two submarine fire control systems, each developed independently with the same aim—to develop the external picture for ship and weapon employment—have been compared and the information about how the algorithms perform is being exchanged to ensure that both systems can improve to deal with the demanding operations in the littorals.
- The adaptation of U.K. periscope employment procedures to U.S. operations.
- The initiative towards the Automatic Identification System and its effective employment within submarines to maintain their safe operation in any area.
- Exchange of information regarding the use of non-hull penetrating visual systems (photonics in the U.S. and optronics in the U.K.) to ensure that knowledge and lessons learned from the operation of the new non-hull penetrating masts on the *Virginia*-class are passed to the *Astute*-class.
- The swift development of tactics and equipment to contribute effectively to information operations.
- The exchange of information regarding situational awareness tools and human system interface to enable effective dominance of the littoral battle space and effective contribution by the submarine to the joint warfare environment.

Establishing the Special Relationship

The predecessor to the MWC, the Submarine Tactics and Weapons Group (STWG), was established using Submarine Development Group TWO (DEVGRU 2) as its model. Cmdr. Jim Conway, USN, and Maurice Fox, a civilian analyst, both from DEVGRU 2, aided the Royal Navy (RN) in the formation of STWG. STWG conducted torpedo firings and analysis, which DEVGRU 2 did not do. However, DEVGRU 2 had its own submarines, which was a critical advantage to TD. In the early 1960s, DEVGRU 2, realizing the benefits of tactical analysis, established a tactical analysis group due in large part to the strong recommendations and influence of the RN exchange officers, Lt. Cmdr. Robin King and Cmdr. Peter Hamilton-Jones.



U.S. Navy photo

Crew members man the bridge of the *Los Angeles*-class fast attack submarine USS *Annapolis* (SSN-760).

The process of effective tactical cross-pollination was already in place when STWG and DEVRON 12 started working together; it is worth noting that some of the officers who had served as RN exchange officers in the U.S. went on to command STWG and some who served as U.S. Navy exchange officers in the U.K. went on to command DEVRON 12, thus aiding the process further.

The importance of civilian support was realized in the 1970s, and from 1974 until 1995 TD contractors¹ supported the joint U.S./U.K. TD project. This project, funded by both the USN and the RN, addressed tactical projects of joint interest. TD exercises focused towards dealing with the Cold War threat and units from both nations exercised in well-structured exercises. The successful analysis resulted in the establishment of effective tactics to deal with potential enemy submarines, particularly in the realms of close encounters, active search methods, initial towed array tactics, and the target motion analysis algorithms.

Additionally, annual meetings were conducted at DEVRON 12 and STWG as a formal method of aligning the state of tactical development and support of both nations' doctrine.

The Exchange Officers

The Coordinated Operations (N74) post (originally the RN Exchange Officer post) working for CSDS 12, was established in 1955 and has always been manned by a command qualified (post-Submarine Commanding Officers Course) lieutenant commander. In previous years when the U.K. diesel submarine capability was still

maintained, the chances were that the officer had already been in command of a submarine. Lt. Cmdr. Ramsey (current N74) and his two direct predecessors have all been employed as one of three command riders for Flag Officer Sea Training (FOST) in the U.K. prior to the CSDS 12 appointment. An exceptionally demanding appointment, the responsibilities as a sea trainer are to train a submarine command team at sea for operations as directed by Chief of Staff Warfare for Fleet Headquarters.

This process is similar to a pre-overseas movement work up. The command rider and his team of up to twelve officers and senior ratings are generally embarked for a period of four weeks providing “cradle to grave” training in the full spectrum of submarine operations.

The FOST command riders also provide training, guidance, and acclimatization for several nations’ diesel submarines and crews (e.g. Canadian, Dutch, German, Italian, Norwegian, Polish, Pakistani, etc.) who operate in U.K. home waters or NATO exercises, or have requested the basic training.

This experience has proven vital to ensuring well-structured exercises, effectively liaising with a variety of nations, and providing an insight into the mind of diesel submarine commanding officers. The command rider’s responsibilities have diverged from the initial exchange program, and in addition to TD, he also assists with training DEVRON 12 submarines at sea.

The U.S. officer serving in the MWC is a post-department head and pre-Submarine Command Course candidate. He works alongside U.K. and Australian counterparts (the Australian is in a post-command tour). He and the CSDS 12 Royal Navy officer liaise continually to ensure that the correct level of collaboration is achieved within a variety of organizations, to the point of being a broker between various agencies.

In addition to the almost weekly communication between both units, an annual series of joint talks is organized with venues alternating between the U.S. and the U.K. These talks provide a face-to-face opportunity for both organizations to align the state of progress in a variety of spectrums and develop a coordinated approach where possible.

Continuing to Enhance the Exchange

There are many programs to ensure that the coordinated approach to warfare dominance continues and develops. One of those is the cross-pollination of students in the U.K. and U.S. submarine command courses.

The U.K. Submarine Command Course (SCC) is referred to as the “Perisher.” It is exceptionally demanding and has produced submarine COs respected across the world. It teaches the potential commanding officer to push the limits both mentally and physically, as well as how to operate his unit effectively. There is no second chance and the standards are exceptionally high—failure means there is no future in your submarine career.

In a bold initiative signed in 2001, forces from the U.S., U.K., Netherlands, and Norway offered places on their respective command course. The U.K. and the Netherlands have sent personnel to the U.S. command course. The U.S. has sent personnel to all three nations’ courses. Discussions with all students who have attended the U.K. course indicate that they have gained a great deal from the course; the same is true of the U.K. personnel who have attended the U.S. SCC. This exchange of students will continue for the foreseeable future as it is another medium to exchange ideas, processes, and experiences at the front line.

At the beginning of 2006 and for the first time, CSDS 12 was invited to speak at the U.K. submarine warfare conference. The conference provided an excellent medium to recognize the individual efforts of both

nations within submarine warfare, and to determine how both navies can progress together with development and operations.

Rear Adm. Paul Lambert, RN, Submarines and Commander Operations, hosted a dinner for all RN command qualified officers and their command qualified guests. Among the attendees were five previous and present RN exchange officers in DEVRON 12.

The Future

It is certain that this dual approach to ensuring submarine capabilities that at least match—and hopefully exceed—future expectations will continue. Further, CSDS 12 continues to extend cooperation to other partners in the GWOT and in general submarine operations. The efficiency of combining ideas will undoubtedly pay dividends. It will ensure streamlined and effective procurement of equipment and the production of tactics to wage this generation of warfare and the next.

Lt. Cmdr. Ramsey is the Coordinated Operations Officer for Submarine Development Squadron TWELVE.

End Note

- 1 Analysis & Technology, Wagner Associates, and Applied Mathematics

Royal Navy submarine HMS *Sceptre*.



China's Undersea Sentries

Sea Mines Constitute Key Element of PLA Navy's ASW

Author's Note: This article represents the opinions of the authors and not the official assessments or policies of the Department of the Navy or any other agency of the U.S. government. The authors thank Mr. Gabriel Collins for translation assistance on several articles.

Traditionally a continental power, Beijing has not wielded strong naval forces in the modern era. But this is beginning to change now and China is making rapid strides, particularly in the arena of undersea warfare. According to the *New York Times*, China launched 13 submarines during the period 2002-04¹—and this number does not include the recent sale of eight *Kilo*-class diesels from Russia that was accomplished by 2006. Indeed, China commissioned thirty-one new submarines between 1995 and 2005². Less well understood by naval analysts and planners is the People's Liberation Army (PLA) Navy's dynamic mine warfare component. It is important to understand this emerging capability, because sea mines appear to be a big component of Beijing's Anti-Submarine Warfare (ASW) strategy.

This article is part of a larger study that surveyed nearly one thousand Chinese language articles related to mine warfare. The major conclusions of that study are that China's naval mine inventory likely contains some of the world's most lethal systems and that Beijing may be on the cutting edge of mine warfare (MIW) technology and concept development. The study elucidates a preliminary outline of a Chinese MIW doctrine that emphasizes speed, psychology, obfuscation, a mix of old and new technologies, and a variety of deployment methods that target very specific U.S. Navy platforms and doctrines. Two research questions from that larger study are explored in this article: first, what

gists note that "submarines are acutely vulnerable to mines, because passive sonar is not likely to be effective in locating mines, and because submarines have very limited organic mine counter measures (MCM) capabilities."³

Lacking a substantial modern naval history, Chinese naval analysts are scrupulously analyzing foreign naval history for lessons to facilitate their development, and have duly noted the potential for mine warfare to "baffle the enemy, and thus achieve exceptional combat results."⁴ As a Chinese textbook relates, 2,500 ships were sunk by sea mines during WWII.⁵ Another Chinese analysis notes that in the same conflict Germany lost 27

ational deployment. Having systematically analyzed the advantages and disadvantages of these mine-laying platforms, they appear to have concluded that submarine delivery of mines is optimal for offensive, and especially long-range offensive, mining missions. According to one analysis, "The restrictions imposed on submarines by air and naval forces are relatively small, [so] penetrating the enemy's rear area to lay mines is much easier."⁹ Also, according to another report, this platform "has the highest qualities of stealth and potential for surprise ... [because] a vessel set at a distance of 10-15 km outside of a harbor, in a sea area with a depth of about 40 m, will be capable of launching an effective mobile mine to penetrate a sea port..."¹⁰



Chen-1 mine from Qingdao Naval Museum.
Photo by Dr. Lyle Goldstein

is China's potential capability and its ramifications? Second, how is the PLA Navy exploring the linkage between submarines and mine warfare to create new and significant operational capabilities?

Strategic Context

The PLA Navy is making rapid strides in its modernization drive, not only in the arena of submarine development, but lately also in the areas of air defense, intelligence, surveillance, and reconnaissance (ISR) and amphibious warfare. Chinese ASW, however, seems to continue to lag behind. There is still, as yet, no modern PLA Navy (PLAN) surface combatant that is truly optimized for ASW. Moreover, the Chinese Navy continues to be weak in maritime patrol aircraft and helicopters for ASW. Beijing does seem to recognize this flaw in its fleet development program and an increasing pattern of ASW exercises reflects Chinese concern. Indeed, articles in China's military press evince acute concern regarding the capabilities of the U.S. Submarine Force. It seems that the PLA Navy sees mine warfare as a feasible "poor man's ASW"—providing a stopgap measure until Beijing has put a more robust ASW posture into place. Chinese strate-

gists note that "submarines are acutely vulnerable to mines, because passive sonar is not likely to be effective in locating mines, and because submarines have very limited organic mine counter measures (MCM) capabilities."³ Lacking a substantial modern naval history, Chinese naval analysts are scrupulously analyzing foreign naval history for lessons to facilitate their development, and have duly noted the potential for mine warfare to "baffle the enemy, and thus achieve exceptional combat results."⁴ As a Chinese textbook relates, 2,500 ships were sunk by sea mines during WWII.⁵ Another Chinese analysis notes that in the same conflict Germany lost 27 U-boats to mines.⁶ Perhaps not surprisingly, Chinese naval strategists have a keen understanding of Soviet naval doctrine, appreciating in particular how mine warfare was revived during the late Cold War in part for the purpose of countering American nuclear powered fast-attack submarines (SSNs). Indeed, one Chinese survey of ASW explains how new mines emerged in the 1980s "that are more appropriate to the requirements of modern anti-submarine warfare." A detailed Chinese analysis of Russian rocket mines concludes: "...these weapons will attack SSNs too rapidly for countermeasures to engage, and are also rated to be highly effective against the mono-hull construction of U.S. submarines."⁷ Chinese strategists have also very closely analyzed the mine warfare aspects of the Persian Gulf War during 1990-91, noting that although two U.S. Navy (USN) ships were severely damaged, Iraq's MIW campaign had numerous flaws, including an "inappropriate reliance on moored mines [and a failure to execute] long range offensive mine warfare operations." It is now conventional wisdom in the PLA Navy that "relative to other combat mission areas, [the U.S. Navy's] mine warfare capabilities are extremely weak."⁸

PLA Navy strategists envision a wide array of platforms (including non-military vessels) for delivery of sea mines for oper-

China's Naval Mine History

China reportedly possesses between 50,000 and 100,000 mines,¹¹ consisting of "over 30 varieties of contact, magnetic, acoustic, water pressure and mixed reaction sea mines, remote control sea mines, rocket-rising and mobile mines..."¹² People's Liberation Army Navy (PLAN) submarines are said to use the *Chen*-1, -2, -3, and -6 type influence mines, "appropriate for use in the sea area immediately outside of harbor mouths;" the T-5 mobile mine, "appropriate for port channels and sea areas immediately outside a port;" and the Soviet-produced PMK-1 and the Chinese-developed *Mao*-5 rocket rising mines, "appropriate for waters up to 15 kilometers outside a port."¹³

China's remotely controlled mines, such as the EM53 bottom influence mine, are thought to be deactivated by coded acoustic signals to allow the safe passage of friendly vessels, and again activated to prevent the transit of those of an enemy.¹⁴ Remotely controlled mines are well suited to defensive mining purposes, but could be useful in offensive operations as well.

China likely also possesses an inventory of submarine launched mobile mines (SLMMs).¹⁵ Called "self navigating mines" (*zihang shuilei*) in Chinese, these mines are simply torpedo bodies that carry a mine payload to waters inaccessible by other means. Apparently derived from *Yu*-class torpedoes, China's SLMMs would travel along a user-determined course for a set period of time. When SLMMs arrived at their programmed destination (e.g. in the middle of a harbor), the torpedo's engine

would shut off, and the weapon would sink to the bottom where the warhead would be controlled by a fuse similar to that of any other bottom mine.

Significantly, China began to develop rocket rising mines in 1981 and produced its first prototype in 1989.¹⁶ Thus, Beijing has been working on this technology for well over two decades. Today, China reportedly offers two types of rising mines for export.¹⁷ Rising mine systems are moored, but have as their floating payload a torpedo or explosive-tipped rocket that is released when the mine system detects a suitable passing vessel. The torpedo or rocket rises from deep depth to home in on and destroy its intended target, typically a submarine. As one source notes, "The so-called 'directional rocket rising sea mine' is a type of high technology sea mine with accurate control and guidance and initiative attack capacity.... Attack speed [e.g., against a target submarine] can reach approximately 80 meters per second."¹⁸ China's EM52, a guided rocket propelled destructive charge, reportedly has an operating depth of at least 200 meters.¹⁹ Russian rising torpedo mines such as the PMK-2 are said to be capable of being laid in waters as deep as 2,000 meters.²⁰

Recent focus on rocket rising mine development indicates for China "a new understanding of the art of sea mine warfare [whereby] it is essential to implement effective sea mine warfare over a vast range of deep sea areas [and to] develop and equip rocket sea mines capable of ... mobile attack."²¹ The PLA Navy is therefore augmenting its existing inventory of 1970s-80s mines designed to defend littoral areas, most of which "can only be deployed in shallow seas," and only a fraction of which can be deployed in medium depths. In particular, China's navy has "started to outfit vertical rocket rising sea mines, and is energetically developing directional rocket sea mines, rocket rising guided missile sea mines and rocket assisted propulsion sea mines."²²

Research Vectors

An article in China's leading naval publication refers to Russia as "the world's 'sea mine kingdom.'"²³ China has reportedly imported Russian mines, technology, and even engineers to bolster its indigenous MIW programs.²⁴ In this domain of warfare, Russia's wide-ranging assistance has been a natural fit for PLA priorities. While

the true scope of this collaboration remains unknown, Chinese analysts have clearly developed a sophisticated understanding of Russian mine development and doctrine. They note that Soviet interest in sea mines actually waned under Khrushchev, but was subsequently reinvigorated in the late 1960s, as it was realized that for conventional war scenarios, sea mines would play an ever greater role.²⁵ One Chinese article emphasizes that Russia "has continuously paid great attention to the development of high speed undersea rocket techniques."²⁶

Ongoing Chinese research foci suggest, however, that Beijing is not content to rely solely on Russian mines and technology. China appears, for instance, to be keenly interested in developing and enhancing the effectiveness of its indigenous deep water rising mines.²⁷ Scientists at China's Naval Aviation Engineering and Dalian Naval academies have developed methods to predict rocket propelled mine attack probability.²⁸ A variety of additional studies have analyzed launch platform stability,²⁹ underwater rocket propulsion,³⁰ and launch trajectory.³¹ Additional naval mine research examines target tracking,³² blast maximization,³³ and damage to ships.³⁴ Researchers at one of China's top technical universities have analyzed the extent to which targets can react to and evade deep water rising mines,³⁵ and suggest using the passive signature of target vessels to aim the mines.³⁶

Submarines have attracted particular attention as a deployment platform for rising mines. An article by Dalian Naval Academy researchers suggests significant PLAN interest in SLMs.³⁷ A researcher at Institute 705 advocates acquisition of an encapsulated torpedo mine, similar to the Cold War-era U.S. *Captor* mine, which could be laid in very deep waters to attack passing submarines.³⁸ Mine belts—external conformal containers designed to carry and release large numbers of mines—can be fitted to submarines in order to bolster their otherwise limited payloads. One

article emphasizes that the Soviet navy developed a "mine laying module capable of carrying 50 sea mines on either side of the submarine" and states, "For the past few years related PLA experts have expressed pronounced interest in submarine mine belts.... The PLA very probably has already developed submarine mine belts."³⁹ Another source notes, however, that "submarines built after World War II rarely carry mines externally."⁴⁰

Disturbingly, there is some discussion of a theoretical nature in Chinese naval analyses concerning arming sea mines with tactical nuclear weapons. One such analysis, in the context of discussing Russian MIW, notes that nuclear sea mines could sink adversary nuclear submarines from a range of 2000 meters....⁴¹ A second article finds that a nuclear payload is one logical method to increase the destructive power of sea mines,⁴² while a third analysis argues that nuclear MIW is especially promising for future deep-water ASW operations. It concludes: "At this time, various countries are actively researching this extremely powerful nuclear-armed sea mine."⁴³ An article in the July 2006 issue of *Modern Navy (Dangdai Haijun)*, published by the PLA Navy itself, in the context of discussing potential future PLA Navy use of sea mines, also notes the potential combat value of nuclear-armed sea mines. While there is no direct evidence of the existence of such naval tactical nuclear weapons programs in China, these articles do perhaps suggest the need to closely monitor any Chinese efforts in this direction.



Mao-series mine from Qingdao Naval Museum.

Photo by Dr. Lyle Goldstein



Mines are loaded on a *Jiaghu*-class frigate.

Photo courtesy of Jian Chuan Zhi Shi

Training

Recent Chinese MIW exercises have involved air, surface and even civilian platforms extensively. Of particular interest in this forum, however, is that China's navy also considers mine laying from submarines to be "the most basic requirement of submarine warfare."⁴⁴ Mine-laying has become an integral component of recently enhanced Chinese submarine force training⁴⁵ in which crews strive to conduct a wider variety of increasingly challenging exercises attuned to local environmental, hydrographic, and weather conditions.⁴⁶ Such exercises are documented in some detail in the PLA Navy's official newspaper, *People's Navy* (*Renmin Haijun*). In particular, China's navy views submarine delivery of mines as a critical aspect of future blockade operations.⁴⁷ By 2002, mine-laying had become one of the most common PLAN submarine combat methods. Accordingly, PLAN crews train to handle submarines loaded with large quantities of mines.⁴⁸ Drill variants include "hiding and laying mines in deep water."⁴⁹ Broad and deep mine-laying against port targets is also emphasized.⁵⁰

Chinese naval officers recognize the challenges inherent in "penetrating the enemy's anti-submarine forces and laying mines behind enemy lines." According to one PLA Navy captain, "Secretly penetrating the combined mobile formation deployed by the enemy's anti-submarine forces is a prerequisite to fulfilling the mine-laying task."⁵¹ There is some evidence that China may rely on centralized control of its submarines when conducting offensive mining

missions. In carrying out offensive mine blockades, notes one Chinese analysis, "...if there is a shore-based submarine command post to handle command and guidance of the submarine for its entire course, it will not only ensure its concealment but also improve the strike effectiveness of the mines... that are laid."⁵²

The Chinese Navy is working hard to improve the quality of its submarine officers and sailors, including their proficiency in MIW. China's official radio cited PLA Navy submarine detachment torpedo and mine officer Chao Chunyi for achieving sixteen research results in underwater mine-laying training, cutting mine loading time in half, and developing a mine movement control device.⁵³ *Song* Submarine 314 Commander Ma Lixin, a celebrity in China's naval press, recently led an East Sea Fleet submarine detachment to "develop tactical innovations." In the past year, Ma researched and developed over ten new operational methods "including how to carry out a blockade and how to lay mines using conventional submarines." In early 2005, Ma "led his unit to participate in live exercises at sea... they arrived at a designated area to... [lay] mines."⁵⁴ In an early 2005 mine exercise, Ma was charged with evading 'enemy' ASW airplanes, a mine field, and – most difficult of all – an adversary submarine, in order to lay mines in a nearby area. He used his mastery of the local environment, adopted minimum noise navigation speed, eluded the 'enemy' submarine and shore radar and accomplished the mine laying mission on time.⁵⁵ In summarizing such achievements, a source notes, "This year there occurred even more enhanced

submarine mine exercises with step-by-step progress..."⁵⁶

Scenarios

What would PLA Navy MIW operations look like in any potential conflict scenario? It is possible to imagine the extensive deployment of Chinese sea mines in conflicts arising out of hostilities in the South China Sea, or a possible conflict involving the Korean Peninsula. But the most operative scenario for Chinese defense analysts now and in the foreseeable future involves the delicate future status of Taiwan.

The bathymetry of the waters proximate to Taiwan immediately reveals that the Taiwan Strait itself, as well as waters to the immediate north and south (adjacent to the island's largest ports), are shallow enough to create an environment for the use of all types of mines. Although Taiwan's eastern coast has deeper waters, the authors nevertheless believe that by relying on a combination method of deployment (air, surface, submarine and civilian) that a major Chinese MIW campaign could efficiently blockade Taiwan, especially if working in concert with the PLA Navy's submarine force. Chinese analysts, moreover, assess that Taiwan's MCM is inadequate to this challenge and that efforts by Taiwan to deploy its own mines could be dealt with by the PLA.⁵⁷

The above scenario represents the minimum that could be expected from offensive PLA MIW operations in a Taiwan scenario. One Chinese study on ASW suggests that mines are best employed against adversary submarines by laying "mines in the egress routes proximate to the enemy's bases... thus limiting the ability of enemy submarines to get out to the ocean."⁵⁸ Indeed, it is conceivable that the PLA Navy could attempt to lay mines outside foreign bases. Such ranges are well within the endurance limits of PLA Navy submarines. When considering long distance offensive MIW operations, it is perhaps noteworthy that Chinese naval analysts have evaluated the "success" of German submarine mining efforts along the American coast during WWII. The waters around Japan's southern Ryukyus are also susceptible to Chinese offensive mining operations. Another article suggests: "On the basis of a great quantity of research, the PLA believes that U.S. nuclear submarines are very quiet, [are] difficult to... counterattack... [and]

must [be] restrained....”⁵⁹ According to this analysis, this concern has been a major impetus for Chinese research on mobile mines and the priority would be laying “[mobile] sea mines in each channel of the Pacific [Ocean’s] First Island Chain, thereby forming together [a] blockade line [and] preventing U.S. nuclear submarines from entering China’s nearby sea areas.”⁶⁰

Implications

Given increasing economic interdependence, not to mention similar interests on such key issues as terrorism and affordable energy, military conflict between Beijing and Washington is a low probability outcome that would likely be injurious to both states’ interests. The nature of the Pacific Theater, coupled with expanding Chinese capabilities to threaten surface and air assets, puts additional impetus on the U.S. to hedge for all contingencies.

U.S. submarines are highly survivable, but in this case a “mission-kill” damaged submarine may be almost as good to adversary war planners as a destroyed submarine. Moreover, as a recent article in the Spring 2006 issue of *UNDERSEA WARFARE* Magazine notes, “submarine[s]... cannot

use all the mine-clearing tools available to surface ships... pre-cursor sweeping before transiting a minefield is generally not an option...”⁶¹ [“Underwater Stealth: Mine Countermeasures’ Ace in the Hole” *UNDERSEA WARFARE*, Spring 2006, pg. 12]

Although China’s naval development program remains rather opaque, it is clear mine warfare is a dynamic component of that program. The sources discussed above further suggest mine warfare may be a central component of China’s evolving ASW doctrine. This has a variety of important implications. First and foremost, a strong consciousness with respect to the Chinese mine challenge should be developed. Training and doctrine must adjust accordingly. Programs related to submarine mine detection and neutralization deserve additional impetus. Second, the Navy should be actively involved in a mine warfare deterrence strategy. Nations should understand that the widespread use of mines in any maritime conflict would be extremely costly as these weapons could be deployed effectively against themselves. Finally, U.S. Navy planning must consider that the PLA Navy is preparing a strategy to counter

American SSNs, such that deployment in a conflict scenario would entail new risks.

Endnotes for this article are available in the online version, available at http://www.chinfo.navy.mil/navpalib/cno/n87/usw/issue_33/index.html.

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A *Chen*-series bottom mine is handled aboard a Chinese surface warship.



Photo courtesy of Jian Chuan Zhi Shi



V O I C E S

from Virginia

EARLY IMPRESSIONS FROM A FIRST-IN-CLASS

Much has been written about USS Virginia (SSN-774) and the current and future ships of the class. It has been well established that the Virginia-class submarine was the first submarine, and the first warship, designed by the U.S. Navy specifically to face post-Cold War threats. These threats dictate that Virginia, while retaining blue water supremacy, must also be able to conduct a wide range of littoral missions that emphasize an entirely new set of capabilities. Although the first crews of Virginia sailed aboard her confident in the integrity of her design and eager to test her advertised capabilities, they were pleasantly surprised to discover that, with a little ingenuity and a willingness to experiment, they were able to coax a few surprises out of Virginia.

While *Virginia* can still go fast and deep to counter traditional blue water surface and sub-surface threats, she has been optimized for littoral missions. These could range from Intelligence, Surveillance, and Reconnaissance (ISR) to Tomahawk strike to deployment of Special Operations Forces (SOF), such as Navy SEALs. This is a wide range of missions, and the crew must be able to execute all assigned mission requirements.

Virginia's hallmark is adaptability. Crucial to this adaptability are the many ways in which she has been designed with reconfigurable capabilities. For example, like the *Los Angeles*-class submarines, *Virginia* is designed with four torpedo tubes. These can potentially deploy MK 48 ADCAP torpedoes, Tomahawk missiles, mines, and Unmanned Underwater Vehicles (UUVs). However, that is where the similarities end between the classes' torpedo rooms. *Virginia's* new reconfigurable torpedo room allows her to carry only the weapons and systems needed for a particular mission, or to reconfigure quickly between a wide variety of mission requirements even when forward deployed. According to her current commanding officer (CO), Cmdr. Todd Cramer, the torpedo room is so large and versatile that all torpedo handling gear can be stored at the extreme perimeters of the room, opening a space in the middle large enough to fit the entire crew. In fact,

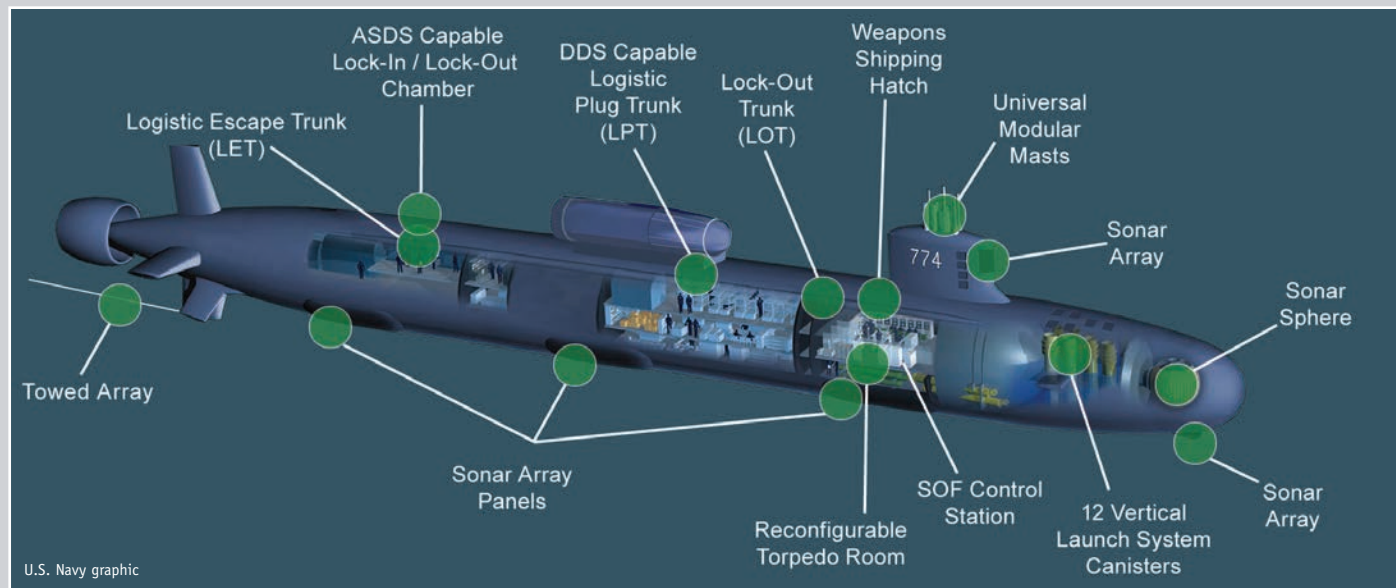
the torpedo room has been used on several occasions for ceremonies requiring the presence of all 134 crew members. While underway in 2005, Cmdr. Cramer routinely took advantage of the torpedo room's ability to reconfigure to accommodate extra bunking modules with only a small load-out of torpedoes. While this capability was conceived specifically with SOF in mind, Cmdr. Cramer used the extra bunks to ensure that *Virginia's* civilian technicians would have their own accommodations while conducting at-sea tests. *Virginia's* Sailors also appreciated this feature, as the submarine was designed with only enough bunks for the crew. With the civilian guests in their own torpedo room bunks, the crew was relieved of the need to hot-rack (where three Sailors share two bunks).

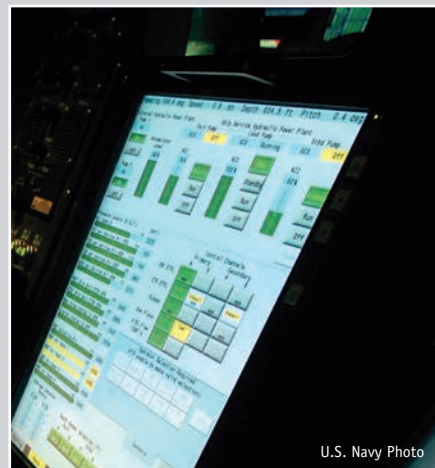
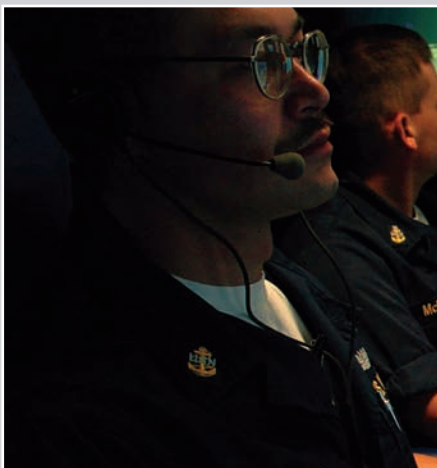
Cmdr. Cramer relates how the Director of Naval Intelligence came aboard *Virginia*, and was interested in the reconfigurable torpedo room and the ship's unique communications capabilities. Previously, the CO had the opportunity to provide input for improved communications. For radio communications, the typical submarine only has voice communication handsets in the radio room and the control room. For the *Virginia*-class design, Cmdr. Cramer asked for that capability in his stateroom, the Executive Officer's (XO) stateroom, the wardroom, and the torpedo room. According to Cmdr. Cramer,

Everyone looked at me funny and said "well why would you want voice radio communications capability in the torpedo room where all the weapons are?" Well it all goes back to this flexibility and adaptability. I envision that the torpedo room can be used as a command and control center and I want the ability of a team down there to be able to talk to both their operators ashore and their bosses. So if we at least put the cabling in and wire it with the connectors, they can bring their own gear, and we just tell them what the specification is and they wire it up into our system, and now they have immediate access to our communications room. Now my radiomen still control the path leaving the ship, but once they line it up, now these guys can talk in a secure mode to whoever they need to talk to, depending on who we're supporting. My focus in my recommendations is to keep the ship adaptable and flexible for the evolving missions that are out there. I cannot predict what we are going to want to use a submarine for in the future, but if we keep it flexible, we can keep this submarine as a viable tool regardless of the situation that the combatant commander is faced with. We're only bounded by our own imagination. And that was why it was a joy to have

(Opposite, left to right) USS *Virginia* returns from Alpha Trials (photo by General Dynamics Electric Boat); sonar screens in the Command and Control Center of *Virginia* (U.S. Navy photo); USS *Texas* (SSN-775) during Alpha Trials (photo by Northrop Grumman Newport News); *Virginia's* radar screens during a surface transit (U.S. Navy photo); USS *Hawaii* (SSN-776) departs for Alpha Trials (photo by General Dynamics Electric Boat); the photonics display board on *Virginia* (U.S. Navy photo).

(Below) A diagram showing many of *Virginia's* capabilities.





U.S. Navy Photo

Chief Petty Officer Jerry Allan Bolte and Senior Chief Petty Officer Scott McIntire operate the ship's control panel aboard *Virginia*.

the Director of Naval Intelligence come down, because I wanted him to envision what we could do, and he's the guy who reads the intelligence stuff trying to figure out "how do you respond to this." So if his viewpoint is based not on older warships and but instead on what the latest capabilities are, he may tailor his intelligence products, he may say "hey maybe we want to share this with the sub force because I think they have a capability that can counter this threat that we're worried about now."

Virginia's control room is also very flexible. The sonar operators and their equipment have moved from a separate room into the control room, and take up most of control's port side. This eliminates the need for the CO to communicate with sonar via speaker box. Furthermore, this design improvement allows the sonar supervisor to have full tactical awareness while assisting the Officer of the Deck (OOD). The control room itself is reconfigurable; the configuration of its many tactical displays can be changed to support whatever mission is being undertaken at the time. The crew has tested several configurations, and has an optimum line-up it normally goes with, but if a component were to fail, the crew could quickly reconfigure the room with no loss of capability.

Virginia employs a different layout for Electronic Support Measures (ESM) than previous submarine classes. On older classes, ESM always shared space in the radio room. On *Virginia*, ESM has been separated from radio, giving each group its own space. This design change has freed six empty bays, or racks, for special operations gear

storage. The increased storage constitutes a true "plug-and-play" type system. *Virginia* provides rack space, electrical power, and cooling for any special equipment that may be needed to conduct a particular mission. This flexibility gives *Virginia* a unique capability to assess and adapt quickly to new threats and enemy vulnerabilities, and allows *Virginia*-class submarines to provide the on-scene commander more intelligence to more effectively conduct operations.

One of the greatest leaps in technology employed aboard *Virginia* is the increased use of automation. This is easily seen in the control room at the ship's control station. On a *Los Angeles*- or *Seawolf*-class submarine, one would normally see four watchstanders at the ship's control station, but on *Virginia* there are only two. The other two have essentially been replaced by computers. This system has been designed for reliability, with quad-redundant computers on a tri-redundant network system that is continually computing the required inputs to the ship's control surfaces to keep her on depth and on course. The computers do not fatigue, and they can perform indefinitely at a level of precision simply unattainable by humans. Although this automated aspect of *Virginia's* design initially was a cause of concern for some, Cmdr. Cramer feels "very comfortable" with it, having operated it and watched it perform in a variety of scenarios, and he "would continue to put this design out to sea." Nevertheless, in the unlikely event that something should fail, there is also a manual mode that the crew is trained to use and practices with constantly. The pilot controls the ship via a joystick that can be held in any manner that is most

comfortable to the operator. While Cmdr. Cramer says that he and the older crew members tend to hold the joystick in front of them or in its cradle, some of the younger pilots take advantage of the flexible cable it is attached to hold it in more comfortable positions, informed by their experience with video game controllers.

Virginia's fly-by-wire controls have also shown off their performance capabilities in high-speed testing. According to Cmdr. Cramer, the ship is extremely stable in the water. He recalls performing guaranteed material inspection (GMI) trials for the survey board whose senior member was a captain.

The captain was worried because we were going to do high-speed runs at flank, and we were going to put the rudder over as hard as we could. He said "Captain, if you want to practice on this ahead of time, we'll just work up slowly, because I know these can be risky evolutions." And I told him "we don't need a whole lot of practice, this ship is very stable." And he was very concerned. So we executed a maneuver in control for a high speed, large rudder turn. And he said "Alright, Captain, enough of the practice run, are you ready to go with the largest rudder you've got?" I responded "Captain, that was the largest rudder there." He was surprised how well the computers kept the ship on depth.

The hydrodynamic characteristics of a submarine are such that when it executes those kinds of turns, the ship can rapidly change depth. The computers detect this depth change, as well as changes in acceleration, and they automatically compensate.



Virginia's advanced torpedo delivery system.



This fly-by-wire system interfaces directly with the hydraulic rams, which made some people nervous initially. However, the operators constantly monitor everything the computers are doing, the crew can see the response of the ship, and at any time, with the simple push of one button that is at the operator's thumb at all times, the submarine can be shifted to manual mode so that human operators are in full control of the ship. Cmdr. Cramer has never needed to take such measures, and in fact notes that the computer will automatically shift to manual mode on its own when it detects it has a problem. When any of the four main computers do not agree, the computer will tell the operator to take manual control. And although the origins of why sailors refer to their ships as "she" are obscured in myth and age-old tradition, *Virginia's* crew has perhaps a more immediate rationale – in the event of a computer failure, it is a female voice that orders the pilot to "take manual control of the planes."

The automation found at the ship control station is also one of the aspects that makes *Virginia* such an appealing platform for special operations forces. Cmdr. Cramer describes one of his submarine's most important SOF capabilities:

I've had this ship at periscope depth, and we were able to hover, and we were able to hold it for three hours. Imagine trying to do this in 688, doing that with the most junior sailors manning the planes, a young seaman or fireman, 18-19 years old, sitting there for three hours trying to hold the ship on depth. The computer is much better at anticipating changes. If you elevate the

sea state a bit, that fight becomes even more challenging, and the computer can predict what the seas will do based on acceleration and velocity, and can counter the action of Mother Nature to hold the ship on depth. This keeps it safe for the SEALs to exit via the lock-out trunk. Our SOF capabilities are really unique. The ship is designed with a lock-out trunk designed to hold nine personnel through a flood-up cycle and an exit cycle. That capability effectively allows you to deploy an entire platoon or squad, depending on what your needs are, and they all go out at the same time. If you look at the old system where they can only send two out at a time, you have two guys in the water waiting for the next two guys to come out. That time in the water is exposure to the environment, so if it's cold water, their stay time is now ticking down while they wait for the rest of their team. Here, the whole team has relatively the same stay time, so they work together as a team. We have the capability to keep the majority of their gear in the lock-out trunk itself, so their combat rubber raiding craft are stored in there, the motors can be stored in there, the fuel is stored up in the sail, and we have specially designed SOF bins where the gas bladders are stored, so they open those from the outside while submerged, they pull the gas bladders out, that's how they fuel their motors. So again, the ship has been optimized to support SOF without reduction in capabilities in other warfare areas.

The lock-out trunk itself extends the width of the submarine, minus a few feet

on the port side where the passageway is located. Tie-down bars are located on the bulkhead to secure the rafts and motors. Grating on the starboard side of the chamber has high-security locks for the storage of ammunition, C-4, and any other explosives that might be carried. The SEALs enter the chamber, plug in to connections for air, shut the hatch, the chamber is flooded, and the water rises to the level of skirt. Once flooded, the chamber is pressurized to match sea pressure. The SEALs manually open the outer hatch, and once out, they shut the hatch and the water is drained out. When the submarine is not using the lock-out trunk for special operations, it is used as an escape hatch. In an emergency, removable walls are used to decrease the volume of the chamber so that the chamber fills with water faster while matching the rescue rate of two sailors per cycle the ship's escape trunks were designed for.

Another one of the unique capabilities on *Virginia* is the photonics mast. This is a non-penetrating mast, so it does not extend physically into the control room. Everything is digitally recorded by cameras up in the mast and transmitted via fiber optics into the ship and processed with on-board image processors. Each photonics mast has three cameras in it; a high-resolution black and white camera, a color camera, and an infrared camera. *Virginia's* designers did not originally envision that the infrared camera would be used 24 hours per day, as it was designed as a night-vision camera. However, Cmdr. Cramer and his crew quickly discovered how versatile the photonics system is. While transiting down the Thames River to Block Island Sound during the day, "we would use infrared on



USS Texas (SSN-775) during Alpha Trials.

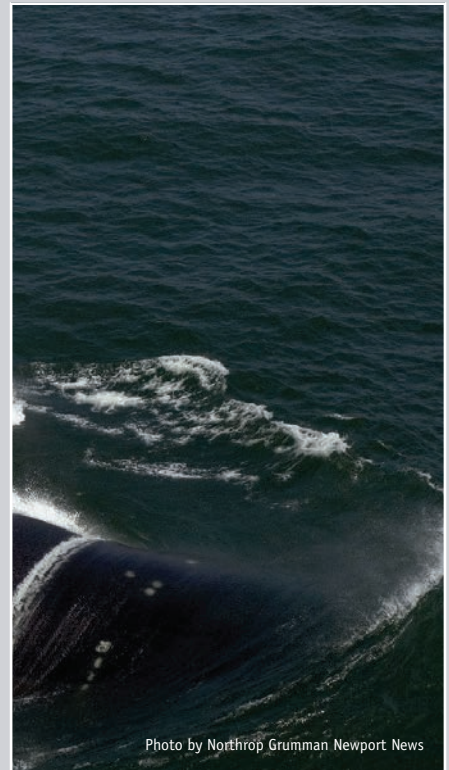


Photo by Northrop Grumman Newport News

the surface, and my team became accustomed to using it because it allowed us to see lobster pot buoys much quicker than the naked eye because the markers reflect heat differently than the adjacent water does, so the ship could easily maneuver around lobster pots or debris in the water.” Similarly,

We learned that the infrared allowed us the capability to detect and classify contacts at night because we could see the entire hull shape, whereas color cameras or normal optics on periscopes only allow you to see light, even low-level light ones; you can only see the light coming off of the contact, but with the infrared camera, I was able to see the heat signature of the entire ship. We were able to pick up an Arleigh Burke-class destroyer and classify her based on the shapes we were seeing, we could see her entire superstructure because her superstructure had a different heat signature than the air and water around it. We could also see which way she was pointing, so we knew what her angle on the bow was, therefore we knew what course she was on, so we could easily maneuver around her.

Virginia-class submarines are designed to take full advantage of open architecture (OA) design concepts. Each ship carries a

significant amount of commercial off-the-shelf (COTS) technology. The combination of OA and COTS allow the operators to plug-and-play very quickly. Because the speed of a computer processor doubles roughly every 18 months, the Navy can rapidly incorporate new technologies as they become available. This process was pioneered for submarine sonar systems, and is now being applied to other electronic combat systems in the boat. Because of the open architecture design, with minor modification and testing the Navy can incorporate the latest technology in its systems and continue to upgrade the Virginia-class platform and keep her state-of-the-art as she progresses through her 30 to 33 year life cycle.

Virginia also employs a unique combination of sonar sensors. Like most U.S. submarines, she has a spherical array forward and a fat line and thin line towed array aft. In addition, the Virginia-class was designed with a wide aperture array, which consists of three large sensor panels down each side of the ship, as well as a high-frequency chin array and a high-frequency sail array. The wide aperture array is capable of automatic ranging of sonar contacts, which allows the CO to develop a solution very quickly, whether for contact management or weapons launch, on a contact held by passive

sonar only. The chin array and the sail array were designed primarily for mine hunting and mine field penetration. Cmdr. Cramer and his crew has been operating the chin array on the surface as they go up and down the Thames River, and the operators have learned that the chin array is surprisingly good at mapping the bottom – so good, in fact, that the sonar operators can tell the navigator when the ship is not on course.

As Cmdr. Cramer elaborates, if you extrapolate that capability to a littoral mission to deploy SEALs in unfamiliar waters, the chin array can map the bottom to detect any risk to the ship or the SEALs. The wide aperture array and the chin array, combined with the advanced processing techniques learned from other systems, make Virginia a platform with an incredible array of sensors available to it that can work in a variety of environments. These sensors and their operators perform one of the key functions Virginia was designed for; delivering information to decision makers, whether onboard the ship or off it, in the right format so that they can make decisions quickly and precisely.

One of the major reasons Virginia was able to deploy so quickly after delivery to the Navy was its capability to do onboard team training. An onboard master computer talks to the training functions of all the onboard

systems, particularly the combat and control systems, and it synchronizes them and provides a synthetic environment in which the operators can train. This capability can be employed both in port and at sea. In port, a master controller can mediate an exercise with sonar, imaging, combat, and radar systems, each with its own training module, but all tied together for the exercise. In addition, *Virginia*'s simulators can be tied in with other ships. For example, USS *Texas* (SSN-775) and *Virginia*, two piers apart at the time this is being written, could see each other in a battle force training scenario. They in turn could be tied into shore simulations in the attack center simulator in the Groton school house, as well as an acoustic range with a live submarine, whose position is being tracked by the range system.

Virginia was involved in many at-sea lead ship trials, and during those trials there were periods of dead time. According to Cmdr. Cramer, trial events did not typically take place on the midwatch (midnight to 0600) because the trials director needed rest and so did some of the key crew members.

Cmdr. Cramer would run training scenarios for the watch section during those time periods to hone their skills in other areas. The training was based on the anticipated needs for the mission they had been tasked with. As a result, the crew and trials personnel were able to concurrently conduct ship trials while conducting training for deployment.

For USS *Virginia*, versatility is the name of the game. She and her sister ships have been designed to excel in the broadest possible conditions, in the broadest possible variety of missions. From traditional blue water missions to the demanding and unpredictable littorals, *Virginia* is designed to provide the combatant commander with the best possible information in order to make the best possible decision. Her design is so strong that she has provided several performance-enhancing surprises to her crew, and it seems that the designers' and crews' imaginations truly are the only limitations to what the *Virginia*-class is capable of in facing the unpredictable post-Cold War environment.

The author wishes to thank *Virginia*'s commanding officer Cmdr. Todd Cramer, former executive officer Lt. Cmdr. Steve Mack, current executive officer Lt. Cmdr. Brian Sittlow, and SUBGRU-2 public affairs officer Lt. Mark Jones for their generous assistance.

Cmdr. Todd W. Cramer was relieved by Cmdr. James P. Waters III after this article was written.

Mr. Holian is a contributing editor to UNDERSEA WARFARE Magazine and a graduate student pursuing a degree in government and international affairs from Virginia Tech.

USS *Hawaii* (SSN-776) during Alpha Trials.

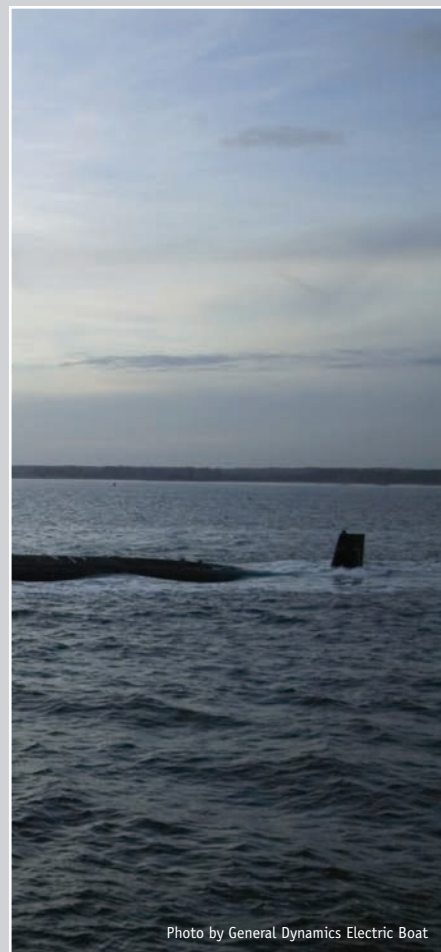
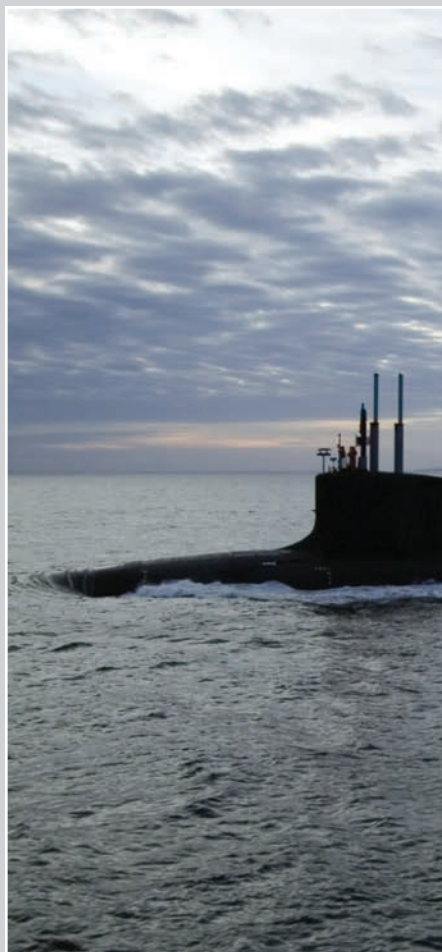


Photo by General Dynamics Electric Boat

MORE FOR LESS

The Navy's Plan to Reduce Costs on *Virginia*-class Submarines While Increasing Production

Building a Fleet for the Future

The task of building and maintaining a properly sized navy is complicated by the significant construction time and cost of modern naval vessels. It requires looking into the future to predict what the Nation will need and balancing that with what the Nation can afford. The Navy has a 30-Year Shipbuilding plan that is designed to provide for a balanced fleet of 313 ships. This battle force is designed to provide the best mix of capabilities to meet the projected 2020 threat while assuming a reasonable level of risk. The Navy's shipbuilding plan balances requirements, affordability, and stability (for both the shipbuilders and Navy budgets).

The Navy has determined that a properly balanced 313-ship fleet contains 48 attack submarines. The current fleet is largely composed of *Los Angeles*-class submarines, but these start to reach their end of life in the next decade and will be decommissioned at a rate of about three per year.

The submarines of the *Virginia*-class are taking their place, the first naval vessel designed for the post-Cold War world. But the current build rate of one *Virginia*-class submarine per year will not support a force of 48 attack submarines. The 2006 Quadrennial Defense Review recommended that the Navy "return to a steady-state production of two attack submarines per year not later than 2012 while achieving an average per hull procurement cost objective of \$2.0 billion [fiscal year 2005 dollars]." The Navy's shipbuilding plan stipulates exactly that, allocating \$4.0 billion (fiscal year 2005 dollars) for the purchase of two *Virginia*-class attack submarines per year starting in fiscal year 2012.

Two For Four In Twelve

This cost goal has become known as "Two for Four in Twelve," two *Virginia*-class submarines per year for \$4 billion (fiscal year 2005 \$) per year in fiscal year 2012. The Navy's *Virginia*-class program office (PMS

450), the shipbuilders (General Dynamics Electric Boat and Northrop Grumman Newport News), and the numerous other companies that support submarine production have been striving together to meet this goal. In order to meet the requirements enumerated above, costs must be reduced by one-sixth. Cost reduction efforts have branched into three specific areas: procurement rate, capability-neutral design changes, and construction performance.

Procurement Rate

Combining the increase in production with the commitment to follow-on construction will result in \$200 million (FY05\$) in cost reductions per-hull—about half of the desired goal. As a result, a significant amount of the cost reduction can be realized by increasing production from one to two submarines per year. There are fixed costs associated with submarine construction, such as shipbuilder overhead costs, and labor hours required as a part of



Photo by General Dynamics Electric Boat



Photo by General Dynamics Electric Boat

(Opposite) USS Hawaii (SSN-776) prior to rollout at General Dynamics Electric Boat. (Above, left to right) Hawaii's sail being added to hull section. North Carolina (SSN-777) hull section.

the construction learning curve. Spreading these hours over two submarines instead of one lowers the effective cost of each submarine.

In addition to reducing the fixed costs, material costs can be lowered as well. Typically, when a submarine is ordered by Congress, it is fully funded in the year that it is authorized to be built. By utilizing a different type of contract with the shipbuilders called a Multi-Year Procurement (MYP) contract, the Navy is permitted to commit to future ships. By doing this, they can take advantage of the Economic Order Quantity (EOQ) provision that permits the purchasing of materials in bulk at a lowered cost. The Navy obtains materials and equipment at a reduced price, while the

shipbuilders enjoy a greater level of stability through the Navy's commitment to future construction.

Capability-Neutral Design Changes

Sometimes a redesign of a system can take advantage of new technology to provide similar levels of performance at reduced levels of cost. There are several proposals for these types of capability-neutral design changes being considered. Two of the most notable include the Large Aperture Bow (LAB) array and the Payload Integration Module (PIM). The forward spherical sonar array on a submarine is large and expensive. Each hull penetration must be inspected and declared seaworthy by the Submarine Safety and Quality Assurance Division

(SUBSAFE). The LAB array would replace the forward sonar sphere. It would be a "wet" sonar system with less expensive components that require less maintenance, last longer, and are less complicated to install. The LAB array has the potential to reduce costs by about \$15 million (FY05\$) per submarine.

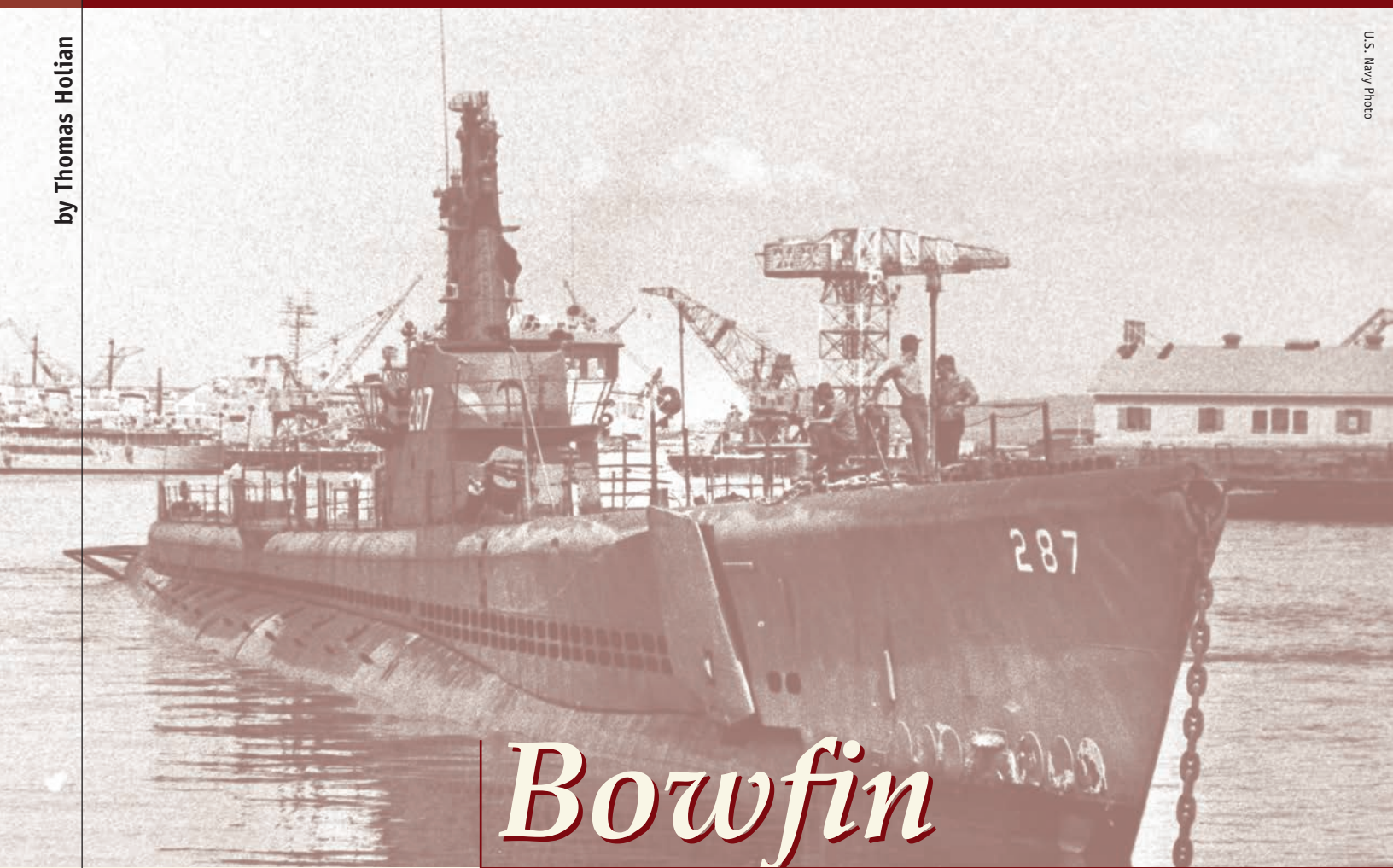
The LAB array would also free up space near the front of the submarine for the PIM. The PIM takes advantage of the modularity of the Virginia-class submarine, one of its key, revolutionary design criteria. A successor to the Vertical Launch System (VLS), the PIM potentially could serve as a modularized, mission configurable weapons bay.

continued on page 28

Hawaii moved outdoors for the first time.



Photo by General Dynamics Electric Boat



Bowfin

The Pearl Harbor Avenger

“Yesterday,
December seventh 1941,
a date which will live in
infamy, the United States
of America was suddenly
and deliberately attacked
by naval and air forces of
the Empire of Japan.”

With these famous words, President Franklin Delano Roosevelt served notice to the world that the previous day's surprise attack on America's Pacific fleet would not go unanswered. Japan had dealt a severe blow to the fleet; by the end of the day of the attack, five battleships were sunk or sinking, three destroyers were wrecked, a minelayer and target ship had capsized, two cruisers were heavily damaged, and many other ships were in need of serious repairs. Navy and Army aviation, Pearl Harbor's air cover, was decimated. In all, the attack left 2,403 Americans dead and 1,178 wounded.

Grievous though the attack was, it was not a complete victory for Japan. The Imperial Forces failed to inflict any damage on Pearl Harbor's aircraft carriers, all of which were at sea, and did not target fuel storage and maintenance facilities, most cruisers and destroyers, and submarines. Submarines in particular were to play a decisive role in the upcoming

war in the Pacific.

In the aftermath of the assault, Japanese Admiral Isoroku Yamamoto, who was responsible for the idea of the surprise attack, is credited with saying “I fear all we have done is to awaken a sleeping giant and fill him with a terrible resolve.” Although it has not been historically proven that he ever uttered or wrote these words, the sentiment holds true: the attack had a galvanizing affect on the American public, and the United States quickly mobilized for entry into World War II. Only eight days after the attack on Pearl Harbor, the Portsmouth Navy Yard was ordered to begin construction on the new *Balao*-class fleet submarine. The third boat of the class, christened USS *Bowfin* (SS-287), was launched on Dec. 7, 1942 – one year to the day after the attack on Pearl Harbor. In honor of this historic coincidence, and with hopes for future wartime success, she was given the nickname

the "Pearl Harbor Avenger."

Bowfin, under the command of Cdr. Joseph H. Willingham, Jr., arrived at Brisbane, Australia, on Aug. 10, 1943 in preparation for her first war patrol. A month and a half later she drew her first blood when she and USS *Billfish* (SS-286) launched a coordinated submerged attack on a large convoy on September 25. *Bowfin* was assigned responsibility for five ships, and managed to sink two, a cargo ship and a tanker, while setting another tanker ablaze. This skirmish was quickly followed two days later by a failed attack on an inter-island steamer due to the receding light of dusk and the desperate maneuvering of the steamer's crew. Following the successful tor-

rilla movement.

The limitations of World War II-era submarine technology often caused sailors to find themselves practically stumbling into extremely dangerous situations. On Nov. 26, on her second patrol, *Bowfin* was running on the surface off the coast of Vietnam in the middle of a pitch-black rainstorm. Nearly blind, *Bowfin* suddenly found herself in the middle of a Japanese convoy and had to back all engines to avoid ramming a tanker. Despite the shock of the near-collision, the crew managed to sink two Japanese ships in a surface torpedo attack. Staying with the convoy, *Bowfin* submerged, and after a two-hour stalk, she sank the Vichy French coastal steamer *Van*

Christie was so taken with *Bowfin*'s performance (and also desiring to see the Navy's notoriously unreliable torpedoes firsthand) that he boarded the boat at Darwin in the middle of her third war patrol, in defiance of his superior officers' denials of his repeated requests to do so. Thus, *Bowfin* became the first U.S. submarine to host a force commander and the first to host a flag officer on a war patrol. Christie acted as a watch officer whenever possible to rest sailors needed for exhausting night attacks, and even served as OOD (Officer of the Deck) during a night surface attack.

Bowfin, it seems, had a special affinity for singular targets. On Aug. 10, 1944, during her sixth patrol, the submarine followed

USS *Bowfin* (SS-287) was launched on Dec. 7, 1942—one year to the day after the attack on Pearl Harbor.

In honor of this historic coincidence, and with hopes for future wartime success, she was given the nickname the "Pearl Harbor Avenger."

pedo attack, *Bowfin* was quick to show her versatility when she sank two small vessels, one carrying about 100 enemy troops on Sept. 30, and a dual-mast schooner on Oct. 2, all with her deck guns while transiting the Celebes Sea.

While on her first patrol, *Bowfin* took part in two secret missions in the Philippines, which had been occupied by the Japanese. The first consisted of a rendezvous with Philippine guerrilla fighters just offshore in Liaugan Bay, Mindanao, to deliver much needed medical supplies, radio transmitters, ammunition, money, and other supplies. The second secret mission took place at the same location on the return trip from the South China Sea. This time, *Bowfin* took aboard nine guerrillas who had been selected by their superior officers for transport to Australia. One of the nine, Samuel C. Grashio, was a U.S. Army Air Corps fighter pilot until he was captured by the Japanese on Bataan. Grashio survived the infamous "Death March" and three different prison camps before escaping from the Davao Penal Colony with a group of ten other prisoners of war and two Philippine convicts, then joining the Philippine guer-

Vollenhoven. This afforded *Bowfin* the rare distinction of featuring a French tricolor on her own battleflag. During the battle, one of the Japanese ships scored hits on *Bowfin*, opening leaks in her starboard induction line. The submarine's crew still managed to fire their last two torpedoes, but they exploded prematurely. Daylight repairs the following morning could not fully stem the flooding, and *Bowfin* was forced to return to Fremantle. En route, *Bowfin*'s new commanding officer, Lt. Cmdr. Walter Thomas Griffith, sighted a "two masted yacht...which...looked like it might have been some planter's yacht taken over by the Japs." *Bowfin* quickly sank the yacht with her deck guns, and returned to base at Fremantle.

As a result of her early success, *Bowfin* was by this point beginning to earn quite a reputation. Her second patrol garnered Griffith the Navy Cross, and the boat and crew were awarded the Presidential Unit Citation. Perth-based Rear Adm. Ralph Waldo Christie, Commander, U.S. Submarine Force, Southwest Pacific (ComSubSoWesPac), praised the patrol as the "classic of all submarine patrols." In fact,

a three-ship convoy into Minami Daito Dock. There, her crew sank two ships, the dock, a crane, and a bus that was being boarded by Japanese sailors. Accordingly, in addition to the French flag representing the Vichy French *Van Vollenhoven*, *Bowfin*'s battleflag features a flag depicting a crane and a bus on a dock. Twelve days later, on Aug. 22, the crew made a night attack on convoy of three cargo ships and two destroyer escorts, sinking all five vessels. Due to the crew's impressive efforts, *Bowfin* was awarded the Navy Unit Commendation. *Bowfin* was one of only five vessels in the entire U.S. Navy to earn both the Presidential Unit Citation and the Navy Unit Commendation.

Historic as this sixth patrol was, it also demonstrated the true horrors of war. Not until twenty years after the end of World War II did *Bowfin*'s crew learn that one of the unmarked, unlighted passenger-cargo targets sunk on the night of Aug. 22 was the *Tsushima Maru*, loaded with 826 children. The children, along with several teachers and parents, were being transported from Okinawa to the mainland of Japan in anticipation of a U.S. invasion of the Ryukyu

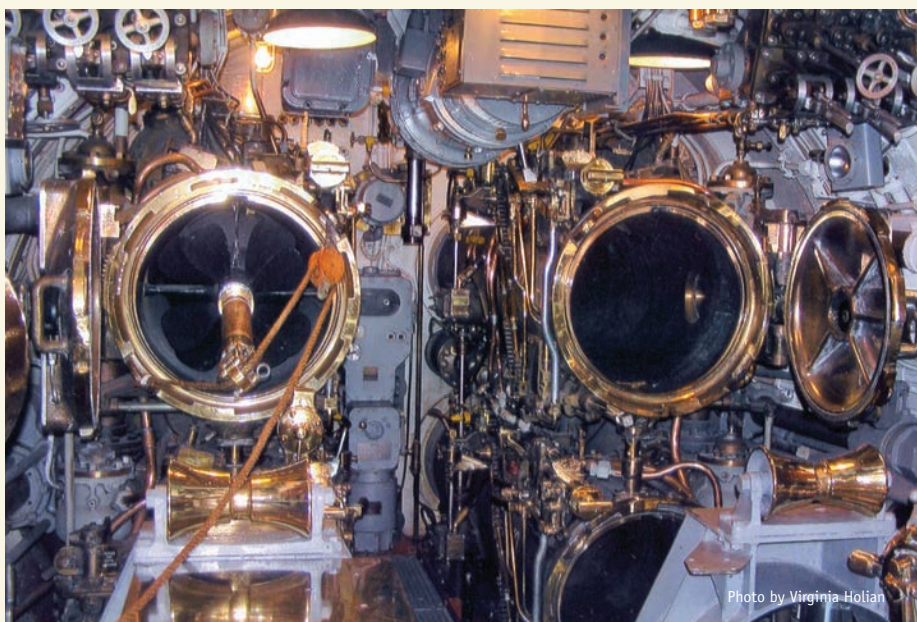


Photo by Virginia Holian

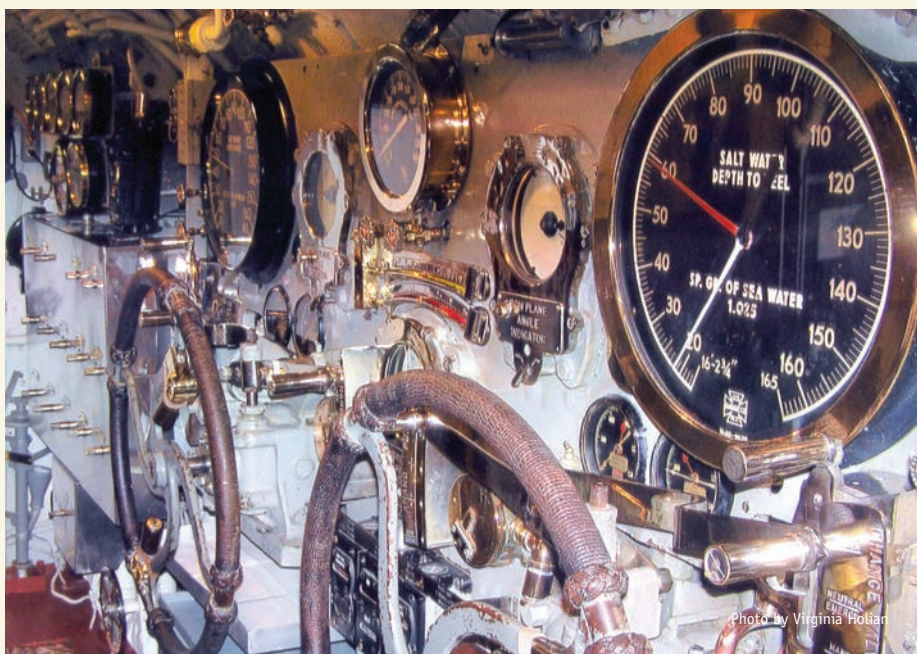


Photo by Virginia Holian

(Top to bottom) *Bowfin*'s forward torpedo room; the control room of *Bowfin*.

merged going through mine fields. We were dodging mines, we were dodging lines and you could hear the line cables hit one side of the bow going bang, bang, bang. There are lines above you and below you. We had fixed the boat up with [a] guard around the bow planes so that if you hit a cable it would direct it off instead of getting hooked and wrapped around the stern plane. We were down about 170 feet going through the minefields. We were going about two knots for almost thirty miles. That is not very fast – it's slower than you walk.

Despite the peril, all nine submarines made it safely through the strait and into the Sea of Japan. *Bowfin* proceeded to her assigned patrol area off the eastern coast of Korea, and on June 11 sighted the 1,898-ton *Shinyo Maru*, sailing unescorted. *Bowfin*'s crew fired four torpedoes, and although only one hit, the cargo ship sank in a mere three minutes. Two days later *Bowfin* torpedoed and sank the 887-ton freighter *Akiura Maru*. As part of the mission, the submarine hunted in several harbors, but they were found to be empty. On June 20, *Bowfin* launched a submerged six-torpedo attack on a convoy of three ships in very shallow water. The attack failed due to several factors, including poor visibility, an inability to maneuver into optimum attack position, and the sudden necessity of avoiding her own fourth torpedo, which appeared to be circling back on *Bowfin*.

On June 24, the Hellcats rendezvoused for their escape run out of the Sea of Japan. Sadly, one of the nine, USS *Bonefish* (SS-223), failed to appear; she is now assumed to have been sunk in a severe counterattack by Japanese escorts after conducting a successful attack on the 5,488-ton cargo ship *Konzan Maru*. The remaining eight members of the wolfpack made a daring high-speed escape out of the Sea of Japan through the narrow, heavily-patrolled La Perouse Strait, completing a circumnavigation of Japan itself. *Bowfin* returned triumphant to Pearl Harbor on Independence Day 1945 at the end of an historic patrol that, in the words of Commander, SUBRON TEN, "...will live long in the annals of submarine warfare." Vice Adm. Charles A. Lockwood

Islands. Of the children on the doomed vessel, 767 were lost and only 59 were saved. Survivors of the sinking were forbidden by the Japanese government to speak of the incident under threat of extreme punishment.

Bowfin's ninth and final wartime patrol, under the command of Cmdr. Alexander Kelly Tyree, was arguably her most noteworthy. She and eight other "Hellcat" submarines were chosen for a near-suicidal mission, codename "Operation Barney," to enter the Sea of Japan and disrupt shipping in "the Emperor's backyard," which had previously been a no-go area for the Allies.

To enter the Sea of Japan, the nine submarines used brand new FM sonar mine detection equipment to navigate the heavily-mined Tsushima Strait. The FM sonar emitted chilling gongs whenever the boat came within 300 yards of a mine, earning it the nickname "Hell's Bells."

The wolfpack's harrowing stealth transit into the Sea of Japan left a lasting impression on their entire crews. *Bowfin*'s helmsmaster assistant navigator, Homer G. Wellar, later recalled the first stage of the mission:

I was on the helm for 17 hours sub-



Photo by Virginia Holian

Bowfin is now preserved as a submarine memorial in Pearl Harbor, Hawaii.

She emerged from the war one of the most successful and highly-decorated U.S. submarines of World War II.

Her record on and under the seas stands today as a mark of the dedication and courage with which America's submariners answered their nation's call.

awarded every Hellcat crewmember a certificate enrolling them as members of the "distinguished order of Mighty Mine Dodgers" for their successful navigation of what he called "the most dangerous of war waters."

En route to her staging area for her tenth war patrol, *Bowfin* received the news of Japan's capitulation and returned home. She emerged from the war one of the most successful and highly-decorated U.S. submarines of World War II. Her record on and under the seas stands today as a mark of the dedication and courage with which America's submariners answered their nation's call. Indeed, the Pearl Harbor Avenger herself now floats quietly in Pearl

Harbor, Hawaii, as a proud memorial visited by thousands of people from around the world who come to pay their respects not only to the men of *Bowfin*, but to all the brave men who served beneath the waves, and especially those who began their "eternal patrol" before the Japanese surrender. In all, 52 of 288 combat submarines (almost one out of five) and 3,505 of 14,750 World War II U.S. submariners (almost one out of four) paid the ultimate sacrifice in defense of their nation, and it is for these men in particular that *Bowfin* stands in silent tribute.

Mr. Holian is a contributing editor to UNDERSEA WARFARE Magazine and a graduate student pur-

suing a degree in government and international affairs from Virginia Tech.

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More for Less: The Navy's Plan to Reduce Costs on *Virginia*-class Submarines While Increasing Production

continued from page 23

Like the LAB array, the PIM would function outside the pressure hull. The PIM has the potential to reduce costs by up to \$20 million (FY05\$) per ship.

To date, capability-neutral design cost reductions have realized about \$5 million (FY05\$) in savings.

Construction Performance

Increasing the efficiency of *Virginia*-class manufacturing and construction processes leads to significant monetary savings. PMS 450 has identified numerous methods by which the Navy can reduce construction costs. Already there have been tremendous gains in performance over the lead ships. USS *Hawaii* (SSN-776) was a rarity, delivered on the original contract delivery date. *North Carolina* (SSN-777) is slated to do the same. *New Hampshire* (SSN-778), the fifth *Virginia*-class submarine, is projected to be delivered up to six months early. Furthermore, both *Hawaii* and *North Carolina* are expected to take 15 percent fewer man-hours to construct than the lead ships.

By shortening the construction time of a submarine from seven years to five years, the fixed costs of construction go down. Reduced construction costs alone have the potential to save the Navy and taxpayers up to \$100 million (FY05\$) in costs, and some of these reductions are already being achieved. Northrop Grumman Newport News-built *North Carolina* is projected to take 10 months fewer to construct than *Texas*, the first *Virginia*-class submarine built by that shipyard.

By changing designs and processes so that it is easier and more efficient to construct submarines, cost reductions in production can be achieved. Over 80 production improvements have been implemented, with a savings of over 65,000 man-hours.

Additionally, the teaming arrangement between Northrop Grumman Newport News and Electric Boat specifies that each company must do half of the work on each submarine. By adjusting the teaming arrangement so that submarines can be built more efficiently between the two shipyards, \$25 to \$50 million (FY05\$)

could be saved.

Capital Expenditures (CAPEX) are a unique form of investment that can lead to cost reductions, and they are part of the current five-year MYP contract. As an incentive to the contract, the Navy funds certain projects submitted by the shipyards that are intended to reduce construction costs. Initial funding is 50 percent of the cost of the project. If the project is completed and results in cost savings, the Navy reimburses the shipbuilder for the remaining 50 percent of the CAPEX outlay. This allows the shipbuilder to modernize its facilities and reduce costs at the same time. Currently, five CAPEX projects have been approved. One of the most significant is the Quonset Point Hull Coating Facility. An initial investment of \$9.4 million is expected to yield a savings of 1,306 man-hours of construction work for each submarine, a total savings of \$71 million over the life of the *Virginia*-class program.

Approximately \$23 million (FY05\$) has been saved through construction performance cost reduction efforts.

The Way Ahead

A year after plans to eliminate \$400 million (FY05\$) from the cost of each *Virginia*-class submarine were announced, over half of the cost savings have been directly targeted, and plans to target the

remaining costs are under development. Commenting on PMS 450's progress to date, Rear Adm. William Hilarides (PEO Submarines) notes that, "The *Virginia*-class program is a mature program, and one that was originally designed with cost effectiveness in mind. In order to reduce costs on this program, we have to change the way we build submarines, and that's what we're doing with the program. I have every confidence that we can meet this goal." The early fruits of the cost reduction plan are expected to be achieved throughout 2007. And as further components of the plan are implemented, the *Virginia*-class submarine program will continue to adapt to provide the best possible platform to the Navy for the best possible price.

Capt. Johnson is the Program Manager for the *Virginia*-class submarine program (PMS 450).

Lt. j.g. Muniz is a Navy Reservist and an analyst with Alion Science and Technology in Washington, D.C.



Texas returns from Alpha Trials.

Photo by Northrop Grumman Newport News



Changes of Command

COMSUBFOR
Vice Adm. Jay Donnelley relieved
Vice Adm. Chuck Munns

COMSUBRON-17
Capt. Charles Richard relieved
Capt. Brian McIlvaine

USS Louisville (SSN-724)
Cmdr. John Sager relieved
Cmdr. David Kirk

USS Nevada (SSBN-733)(G)
Cmdr. Mark Behning relieved
Cmdr. Stan Robertson

USS Santa Fe (SSN-763)
Cmdr. Vernon Parks, Jr. relieved
Cmdr. Steve Perry

USS Topeka (SSN-754)
Cmdr. Daryl Caudle relieved
Cmdr. Dixon Hicks

Qualified for Command

Lt. Cmdr. John Craddock
COMSUBRON-4

Lt. Cmdr. John Croghan
COMSUBRON-1

Lt. Cmdr. Peter Green
COMSUBRON-1

Lt. Cmdr. Robert Haldeman
COMSUBRON-4

Lt. Cmdr. James O'Harrar
COMSUBRON-4

Lt. Cmdr. Glen Sidaris
Naval War College

Lt. Cmdr. Brian Tanaka
COMSUBRON-11

Lt. Cmdr. James Wiest
NAVSUBTRACENPAC,
Pearl Harbor

Lt. Jonathan Staley
COMSUBRON-1

Qualified Nuclear Engineer Officer

Lt. Thomas Delewski
USS Columbia (SSN-771)

Lt. Michael Galle-Bishop
USS Ohio (SSGN-726)(B)

Lt. Craig Hanson
USS Kentucky (SSBN-737)(B)

Lt. j.g. David Bartles
USS Houston (SSN-713)

Lt. j.g. Scott Brewer
USS Columbia (SSN-771)

Lt. j.g. Michael Carrigan
USS Texas (SSN-775)

Lt. j.g. David Chien
USS Jefferson City (SSN-759)

Lt. j.g. Joshua Clements-Sampson
USS Maine (SSBN-741)(G)

Lt. j.g. Deepu David
USS Pennsylvania (SSBN-735)(G)

Lt. j.g. Robert Dawe
USS Nebraska (SSBN-739)(G)

Lt. j.g. Ronald Duncan
USS Alabama (SSBN-731)

Lt. j.g. Sean Flanagan
USS Kentucky (SSBN-737)(B)

Lt. j.g. Kevin Fornal
USS Kentucky (SSBN-737)(G)

Lt. j.g. Kenneth Greenfield
USS Pennsylvania (SSBN-735)(G)

Lt. j.g. Zachary Harper
USS Henry M. Jackson (SSBN-730)

Lt. j.g. Dustin Haug
USS Michigan (SSGN-727)

Lt. j.g. Haney Hong
USS Topeka (SSN-754)

Lt. j.g. Michael Heiny
USS Ohio (SSGN-726)(B)

Lt. j.g. David Johns
USS Greenville (SSN-772)

Lt. j.g. Jeremy Johnston
USS Nebraska (SSBN-739)(G)

Lt. j.g. Thomas Kim
USS Nebraska (SSBN-739)(G)

Lt. j.g. Michael Lopresti
USS Jimmy Carter (SSN-23)

Lt. j.g. Nestor Makris
USS San Francisco (SSN-711)

Lt. j.g. Jeffery Mankey
USS Nevada (SSBN-733)(B)

Lt. j.g. James McCarthy
USS Alabama (SSBN-731)

Lt. j.g. Michael McCarthy
USS Columbus (SSN-762)

Lt. j.g. William McKeown
USS City of Corpus Christi (SSN-705)

Lt. j.g. Nicholas Meyers
USS Columbia (SSN-771)

Lt. j.g. Michael Mulle
USS Ohio (SSGN-726)(B)

Lt. j.g. Reginald Preston
USS Helena (SSN-725)

Lt. j.g. James Prosek
USS Los Angeles (SSN-688)

Lt. j.g. Franklin Reber
USS Henry M. Jackson (SSBN-730)

Lt. j.g. Seth Rumler
USS Kentucky (SSBN-737)(B)

Lt. j.g. Scott Scherer
USS Buffalo (SSN-715)

Lt. j.g. Jesse Skidmore
USS Florida (SSGN-728)

Lt. j.g. Matthew Taylor
USS Kentucky (SSBN-737)(B)

Lt. j.g. Jonathan Tisdall
USS Jefferson City (SSN-759)

Lt. j.g. Gregory Twohig
USS Kentucky (SSBN-737)(B)

Lt. j.g. Michael Vasek
USS Maine (SSBN-741)(G)

Lt. j.g. Douglas Webster
USS Nevada (SSBN-733)(B)

Lt. j.g. Sean Welch
USS Chicago (SSN-721)

Line Officer Qualified in Submarines

Lt. Andrew Mierisch
USS Dallas (SSN-700)

Lt. Brian Ray
COMSUBDEVRON-12

Fair Winds and Following Seas

Robert Young "Yogi" Kaufman died at the age of 82 on Sept. 27, 2006. Vice Adm. Kaufman was a retired submarine commander who spent his time as a photographer, with five published coffee-table books. Before retiring in 1981, he was the executive officer of USS *Seawolf* (SSN-575) and commanded USS *Cavalla* (SSN-684), USS *Scorpion* (SSN-589), and USS *Will Rogers* (SSBN-659). Vice Adm. Kaufman was awarded the Legion of Merit for his time on the *Scorpion* in 1962. He was also among those who set the design specifications of the *Los Angeles*- and *Ohio*-class submarines. He retired as director of command, control, communications, and intelligence.





Lt. j.g. Antonio Alarcon
USS Wyoming (SSBN-742)(G)

Lt. j.g. Jesse Atwood
USS Henry M. Jackson (SSBN-730)

Lt. j.g. Robert Barnett
USS Philadelphia (SSN-690)

Lt. j.g. Matthew Beach
USS Philadelphia (SSN-690)

Lt. j.g. Daniel Bram
USS Nevada (SSBN-733)(G)

Lt. j.g. Daniel Brammer
USS Wyoming (SSBN-742)(G)

Lt. j.g. Benjamin Brumm
USS Rhode Island (SSBN-740)(G)

Lt. j.g. Adam Cadovius
USS Georgia (SSGN-729)

Lt. j.g. Brian Campbell
USS San Francisco (SSN-711)

Lt. j.g. Neil Cayabab
USS Alabama (SSBN-731)

Lt. j.g. Matthew Caylor
USS Santa Fe (SSN-763)

Lt. j.g. Ryan Chamberlain
USS Ohio (SSGN-726)(B)

Lt. j.g. David Crescitelli
USS Alabama (SSBN-731)

Lt. j.g. Joseph Christensen
USS Nevada (SSBN-733)(G)

Lt. j.g. Matthew Christopher
USS Annapolis (SSN-760)

Lt. j.g. Zach Conley
USS Connecticut (SSN-22)

Lt. j.g. Brian Crum
USS Hampton (SSN-767)

Lt. j.g. Robert Dawe
USS Nebraska (SSBN-739)(G)

Lt. j.g. Michael Desmond
USS Nevada (SSBN-733)(B)

Lt. j.g. Steven Dykstra
USS Nevada (SSBN-733)(G)

Lt. j.g. Gregory Edwards
USS Rhode Island (SSBN-740)(B)

Lt. j.g. Joshua Essler
USS Florida (SSGN-728)

Lt. j.g. Stanley Eugene
USS Nebraska (SSBN-739)(G)

Lt. j.g. Brandon Ferran
USS Nebraska (SSBN-739)(G)

Lt. j.g. John Fiamengo
USS Rhode Island (SSBN-740)(B)

Lt. j.g. Jose Flores
USS Charlotte (SSN-766)

Lt. j.g. Joshua Fogle
USS Hampton (SSN-767)

Lt. j.g. Joseph Fontenot
USS Augusta (SSN-710)

Lt. j.g. William Fry
USS Santa Fe (SSN-763)

Lt. j.g. David Garmon
USS San Juan (SSN-751)

Lt. j.g. Steven Goocey
USS Dallas (SSN-700)

Lt. j.g. Kevin Gorecke
USS Dallas (SSN-700)

Lt. j.g. Rodney Grogan
USS Ohio (SSGN-726)(B)

Lt. j.g. David Hart
USS Minneapolis-Saint Paul (SSN-708)

Lt. j.g. Ryan Heineman
USS Minneapolis-Saint Paul (SSN-708)

Lt. j.g. Jeremy Johnston
USS Nebraska (SSBN-739)(G)

Lt. j.g. Jacob Jones
USS Nevada (SSBN-733)(B)

Lt. j.g. Jon Kalscheuer
USS Columbia (SSN-771)

Lt. j.g. Thomas Kim
USS Nebraska (SSBN-739)(G)

Lt. j.g. William LaFleur
USS La Jolla (SSN-701)

Lt. j.g. Jason Looper
USS Kentucky (SSBN-737)(B)

Lt. j.g. Michael Lutes
USS Maryland (SSBN-738)(B)

Lt. j.g. Daniel Manteufel
USS San Juan (SSN-751)

Lt. j.g. Gregory Markham
USS Kentucky (SSBN-737)(G)

Lt. j.g. Christopher Meilstrup
USS Asheville (SSN-758)

Lt. j.g. Christopher Miles
USS Philadelphia (SSN-690)

Lt. j.g. Michael Miller
USS Maine (SSBN-741)(G)

Lt. j.g. Kevin Moeller
COMSUBDEVRON-12

Lt. j.g. Nicholas Moody
USS Pasadena (SSN-752)

Lt. j.g. Jonathan Moser
USS Nebraska (SSBN-739)(B)

Lt. j.g. Daniel O'Connor
USS Hampton (SSN-767)

Lt. j.g. Erik Petersen
COMSUBDEVRON-12

Lt. j.g. Matthew Powell
USS Rhode Island (SSBN-740)(B)

Lt. j.g. Matthew Rehberg
USS Jefferson City (SSN-759)

Lt. j.g. Christopher Rials
USS Michigan (SSGN-727)

Lt. j.g. Brant Robinson
USS Texas (SSN-775)

Lt. j.g. David Schiff
USS Nebraska (SSBN-739)(G)

Lt. j.g. Adam Schmiedeknecht
USS Bremerton (SSN-698)

Lt. j.g. Jeread Sines
USS Alexandria (SSN-757)

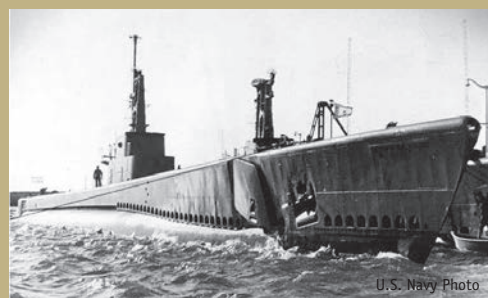
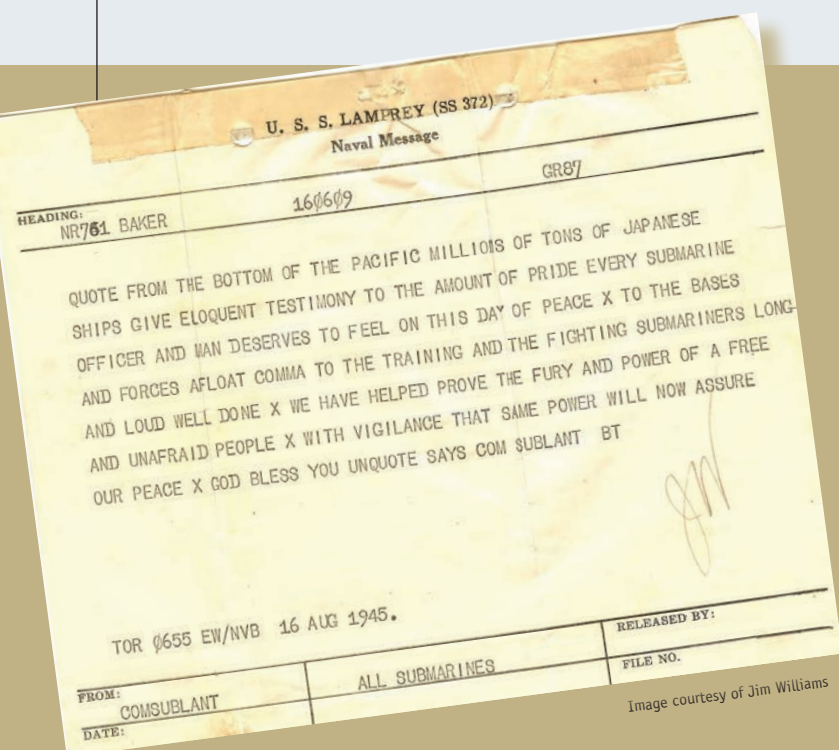
Lt. j.g. Gregory Sham
USS Pennsylvania (SSBN-735)(G)

Lt. j.g. Albert Stolz
USS Helena (SSN-725)

Lt. j.g. Dustin Springer
USS West Virginia (SSBN-736)(G)

Lt. j.g. Morris Tichenor
COMSUBDEVRON-12

Lt. j.g. Jose Trevino
USS Ohio (SSGN-726)(B)



USS Lamprey (SS-372)

This message from Commander, Submarine Forces Atlantic, dated Aug. 16, 1945, gives a hearty BZ to the Submarine Force following Japan's unconditional surrender two days prior.

Image courtesy of Jim Williams



USS *La Jolla* CO Honored With Prestigious Stockdale Award

by Lt. Justin Cole, Chief of Naval Personnel Public Affairs

Chief of Naval Operations, Adm. Mike Mullen presented the Vice Adm. James B. Stockdale Leadership Award to Cmdr. Richard L. Clemmons Jr. and Cmdr. Brian T. Howes Nov. 14 in the Pentagon's Hall of Heroes, a room paying tribute to those who have been awarded the Congressional Medal of Honor.

"As officers in the Navy, we are many things," said Mullen, "but first and foremost, we are leaders. These two officers represent the epitome of leadership and are a credit to the commands they represent."

The award, established in honor of Vice Adm. James Bond Stockdale, is presented annually to two commissioned officers on active duty below the grade of captain who are in command of a single ship, submarine, aviation squadron, or operational warfare unit at the time of nomination. It is awarded in honor of Stockdale's distinguished naval career symbolizing the highest standards of excellence and leadership.

Unlike most other Navy awards, recipients of the Stockdale Award must be nominated by their peers who themselves must be eligible for the award.

"We are, by nature, a competitive outfit," said Mullen, a 1987 recipient of the award. "The fact that these two gentlemen were nominated by others who are competing with them speaks volumes of their character."

Both winners thanked the crews of the ships they commanded, as well as their families and friends who aided them in their careers. Clemmons, who commanded USS *Roosevelt* (DDG-80), paid special tribute to his uncle who is in a wheelchair and made the trip from Pittsburgh, Penn.

"I've never seen my Uncle Bill stand a day in his life," Clemmons said. "But in my eyes he stands taller than anyone else I have ever met. He is my inspiration."

Howes thanked former commanding officers for giving him the guidance to get him to where he is today, but reserved most of the



U.S. Navy photo

Chief of Naval Operations (CNO) Adm. Mike Mullen presents Cmdr. Brian T. Howes, commanding officer USS *La Jolla* (SSN-701), the Vice Adm. James B. Stockdale Award for Leadership in the Hall of Heroes at the Pentagon.

credit for the award for his crew of USS *La Jolla* (SSN-701).

"I feel kind of like the coach taking credit for winning the big game," said Howes. "I was fortunate enough to inherit an incredible group of Sailors who worked together to achieve extraordinary things."

While Howes and Clemmons agreed there was no magic formula for success, they pointed towards their crews as being the keys to their successful command tours.

"What you believe, you will become," said Clemmons. "If you believe you're the best crew in the Navy, then that's what you'll be."

Lt. j.g. Robert Walls
COMSUBRON-6

Lt. j.g. Frederick White
USS Hartford (SSN-768)

Lt. j.g. Anthony Wilson
USS Florida (SSGN-728)

Lt. j.g. Matthew Winterboer
USS Texas (SSN-775)

Lt. j.g. David Zinkhon
USS Nebraska (SSBN-739)(G)

Supply Corps Qualified in Submarines

Lt. Paul Carey
USS Wyoming (SSBN-742)(G)

Lt. William M. Jakubowicz
COMSUBRON-8

Lt. j.g. Eric Underwood
USS Wyoming (SSBN-742)(G)

Lt. j.g. Timothy Winn
COMSUBRON-6

Ens. Daniel Neubauer
USS West Virginia (SSBN-736)(G)

Limited Duty Officer Qualified in Submarines

Lt. Todd Sullivan
USS Florida (SSGN-728)

Ens. Ricardo Lopez
COMSUBRON-6

Limited Duty Officer Qualified in Surface Warfare

Ens. Sammie Green
USS Emory S. Land (AS-39)

Ens. Henry Gudino
USS Emory S. Land (AS-39)

Chief Warrant Officer 2
Rodney Norwood
USS Emory S. Land (AS-39)

Medical Officer Qualified in Surface Warfare

Lt. Michael Fraser
USS Emory S. Land (AS-39)

Special Recognition—Battle "E" Winners

USS Albuquerque (SSN-706)

USS Alexandria (SSN-757)

USS Chicago (SSN-721)

USS Emory S. Land (AS-39)

USS Frank Cable (AS-40)

USS Houston (SSN-713)

USS Hyman G. Rickover (SSN-709)

USS Jefferson City (SSN-759)

USS Kentucky (SSBN-737)(B)

USS Kentucky (SSBN-737)(G)

USS La Jolla (SSN-701)

USS Nevada (SSBN-733)(B)

USS Norfolk (SSN-714)

USS Tennessee (SSBN-734)(B)

USS Tucson (SSN-770)

USS Seawolf (SSN-21)

NR-1

ARCO (ARDM-5)

Swamp Fox (TWR-821)



Father, Son Submariners Reunite in Bahrain

by Petty Officer 2nd Class Michael Zeltakalns

As Capt. Duane Ashton stood on the pier that cold morning in January, he had no reason to believe he would see his oldest son again for quite a long time. Nuclear-trained Machinist Mate 2nd Class Jonathan Ashton, assigned to the engineering department aboard USS *Scranton* (SSN-756), was beginning a six-month deployment as part of the USS *Bataan* Expeditionary Strike Group (ESG).

From his own 28 years of experience as a submariner, Capt. Ashton knew what to expect—few, if any phone calls and sporadic email. Submarine service is a largely silent service.

Adding to the disconnect, Capt. Ashton was preparing for his own deployment to Iraq as the chief of staff of the Regime Crimes Liaison Office. Between his son's deep-sea service and his Individual Augmentee (IA) duty, he knew the family wouldn't be together again for many months.

Fortunately, he was wrong.

Four months and nearly 7,000 miles later, the father and son submariners reunited in Bahrain, but the road wasn't easy.

"It was a real challenge to leave Baghdad and come down here to see Jonathan, but I knew it was a once-in-a-lifetime opportunity," said Capt. Ashton. "It's a great blessing to be here and spend some time with my son."

"It's a little bit surreal," admits Petty Officer Ashton. "I never thought I'd see my father in the Middle East." With only four days to replace four months of lost time, the two worked hard to make the most of their time together.

"We've been spending some great quality time together, doing a little shopping. Really, we're just trying to catch up," said Capt. Ashton.

Separation is nothing new for the Ashton family. Capt. Ashton's career as a submariner has meant many moves and long separations, but this is the first time both father and son have been deployed at the same time. Petty Officer Ashton says for their family back in Alexandria, Va., these are trying times.



Photo by Seaman Joshua Cassatt

"Mom's nervous, very nervous," said Petty Officer Ashton. "With both of us in this [area of responsibility], it's been tough."

Capt. Ashton agrees. "This has been the toughest deployment, I think, because I was going to Iraq, and there's some uncertainty there," admits Capt. Ashton. "Without her support, I wouldn't be standing here with you doing this interview."

As the two head back to work, Petty Officer Ashton is already thinking about the next time they'll meet. "I'm looking forward to going home, seeing my family and my girlfriend," he said. "And sunlight, I miss sunlight."

Scranton left its homeport Jan. 7 on a regularly scheduled deployment in the U.S. 5th Fleet area of operations in support of Maritime Security Operations (MSO). MSO help set the conditions for security and stability in the maritime environment, as well as complement the counter-terrorism and security efforts of regional nations. These operations deny international terrorists the use of the maritime environment as a venue for attack or to transport personnel, weapons, or other material.



Photo by Seaman Apprentice Matthew Ebarb

Submarine Legend Honored

Retired Congressional Medal of Honor recipient Rear Adm. Eugene Fluckey receives recognition from Vice Adm. Charles Munns, former Commander, Naval Submarine Forces, at the Arbor Nursing Home in Annapolis, Md. Fluckey received the Congressional Medal of Honor for gallantry as commanding officer of USS *Barb* (SS-220) in 1944.

Don't Miss the Boat...

UNDERSEA WARFARE Magazine is looking for this year's top submarine related photos for the 9th Annual Photo Contest, sponsored by the Naval Submarine League. The best of the best will be published in the Summer 2007 issue.

Note: Entries must be received by June 22, 2007. However, time permitting, photos received shortly after the deadline will be considered. Photos must be at least 5" by 7", at least 300 dots-per-inch (dpi), and previously unpublished in printed media. Each person is limited to five submissions, which can be sent as JPGs or other digital photo formats to the e-mail address to the right. Printed photos can also be mailed to the following address:

Military Editor
Undersea Warfare CNO
2000 Navy Pentagon
Washington, D.C. 20350-2000
or email underseawarfare@navy.mil

CASH PRIZES for the top 4 photos!

1ST Place **\$500**

2ND Place **\$250**

3RD Place **\$200**

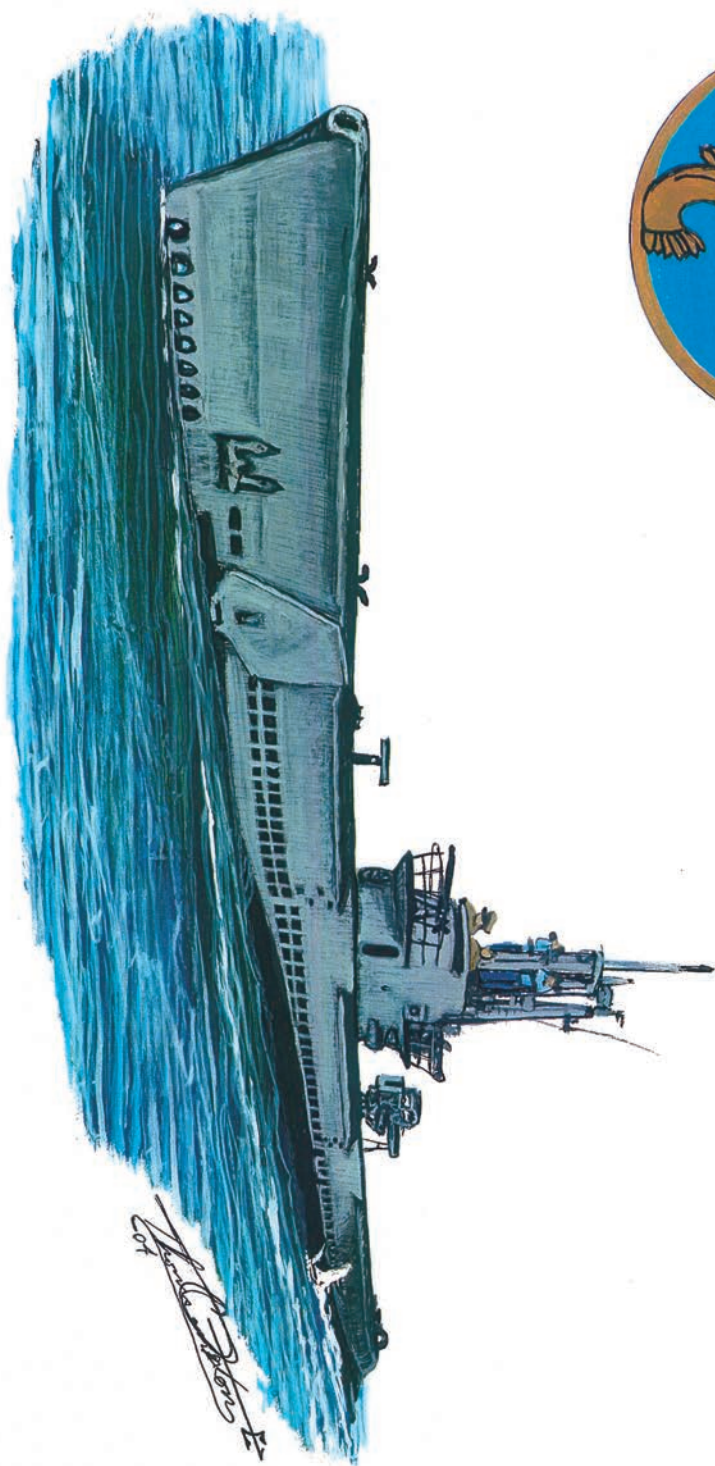
Honorable Mention **\$50**



On The Back

Bowfin (SS-287) was the third commissioned boat in the Balao-class. Launched in 1942, she served the U.S. Navy for 12 years before becoming a memorial to the dedicated men who lost their lives aboard submarines during World War II.

Thomas Denton was born Sept. 13, 1955, and joined the U.S. Navy in 1973. Completing recruit training in Great Lakes, Ill., he went to Submarine School in Groton, Conn. followed by Polaris Electronics "A" School and Ships Inertial Navigation "C" School at Dam Neck, Va. Initially Qualified on the George C. Marshall (SSBN-654), he also served on the Holland (AS-32), Francis Scott Key (SSBN-657), and Canopus (AS-34). As a self-taught artist, he became plankowner of the St. Marys' Submarine Museum located in St. Marys, Ga. and staff artist of the American Submariner Magazine for U.S. submarine veterans. Tom is currently employed as a systems analyst for BAE Systems and lives in Walkersville, Md. with his wife Debbie and three children, Angela, Kim, and Justin.



USS BOWFIN
SS - 287



“USS Bowfin (SS-287)”

Thomas Carl Denton, Chief Petty Officer, USN (Ret.)